US006055509A

United States Patent [19]

Powell

[11] **Patent Number: 6,055,509**

[45] **Date of Patent: Apr. 25, 2000**

[54] **SYSTEM AND METHOD FOR TRANSFERRING IDENTIFICATION INFORMATION BETWEEN PORTABLE CARDS IN A COMPUTERIZED RETAIL STORE HAVING COMMUNICATION AMONG A PLURALITY OF COMPUTERS**

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[73] Assignee: **Ken R. Powell**, Athens, Ga.

[21] Appl. No.: **08/799,689**

[22] Filed: **Feb. 11, 1997**

[51] **Int. Cl.**[7] **G06F 17/60**

[52] **U.S. Cl.** **705/14**; 235/383; 705/30

[58] **Field of Search** 705/14, 1, 16, 705/30, 400; 235/383

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,674,041	6/1987	Lemon et al.	705/14
4,882,675	11/1989	Nichtberger et al.	705/14
4,896,791	1/1990	Smith	221/7
4,937,742	6/1990	Marshall	705/14
5,047,614	9/1991	Bianco	235/385
5,250,789	10/1993	Johnsen	705/14
5,256,863	10/1993	Ferguson et al.	380/24
5,380,991	1/1995	Valencia et al.	235/383
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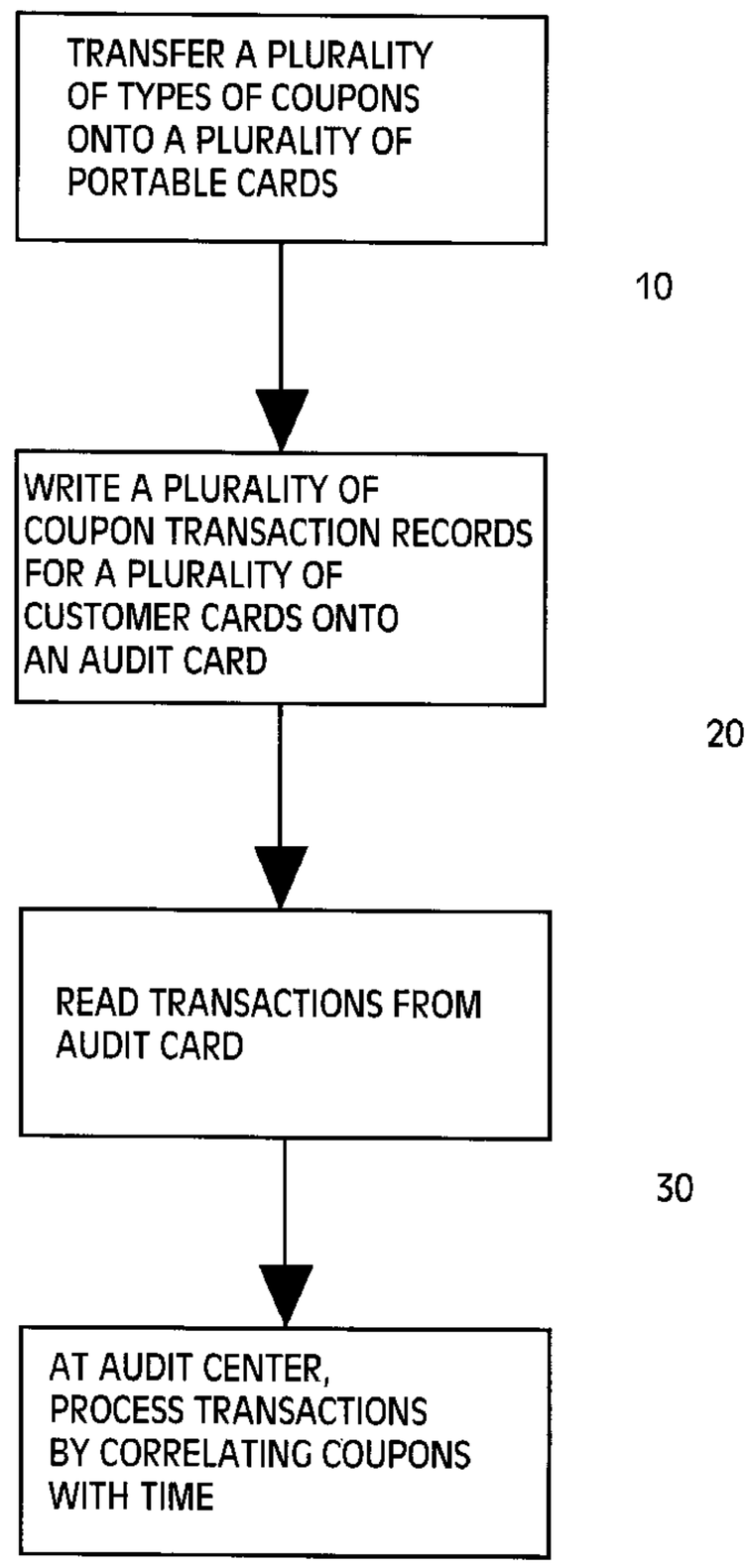
Latamore, Bert, "The Smart Card," Desktop Computing, Aug. 1982, pp. 46–51.

Primary Examiner—Emanuel Todd Voeltz
Assistant Examiner—Raquel Alvarez
Attorney, Agent, or Firm—Jerome D. Jackson

[57] **ABSTRACT**

A system for auditing coupon distribution in a retail store. The system includes a plurality of retail stores, each having a coupon-dispensing unit for writing electronic coupons onto portable IC cards carried by each customer. To audit the system, store personnel insert an auditing card into the coupon-dispensing units, to collect the dates and recipients of coupon-dispensing transactions.

29 Claims, 27 Drawing Sheets



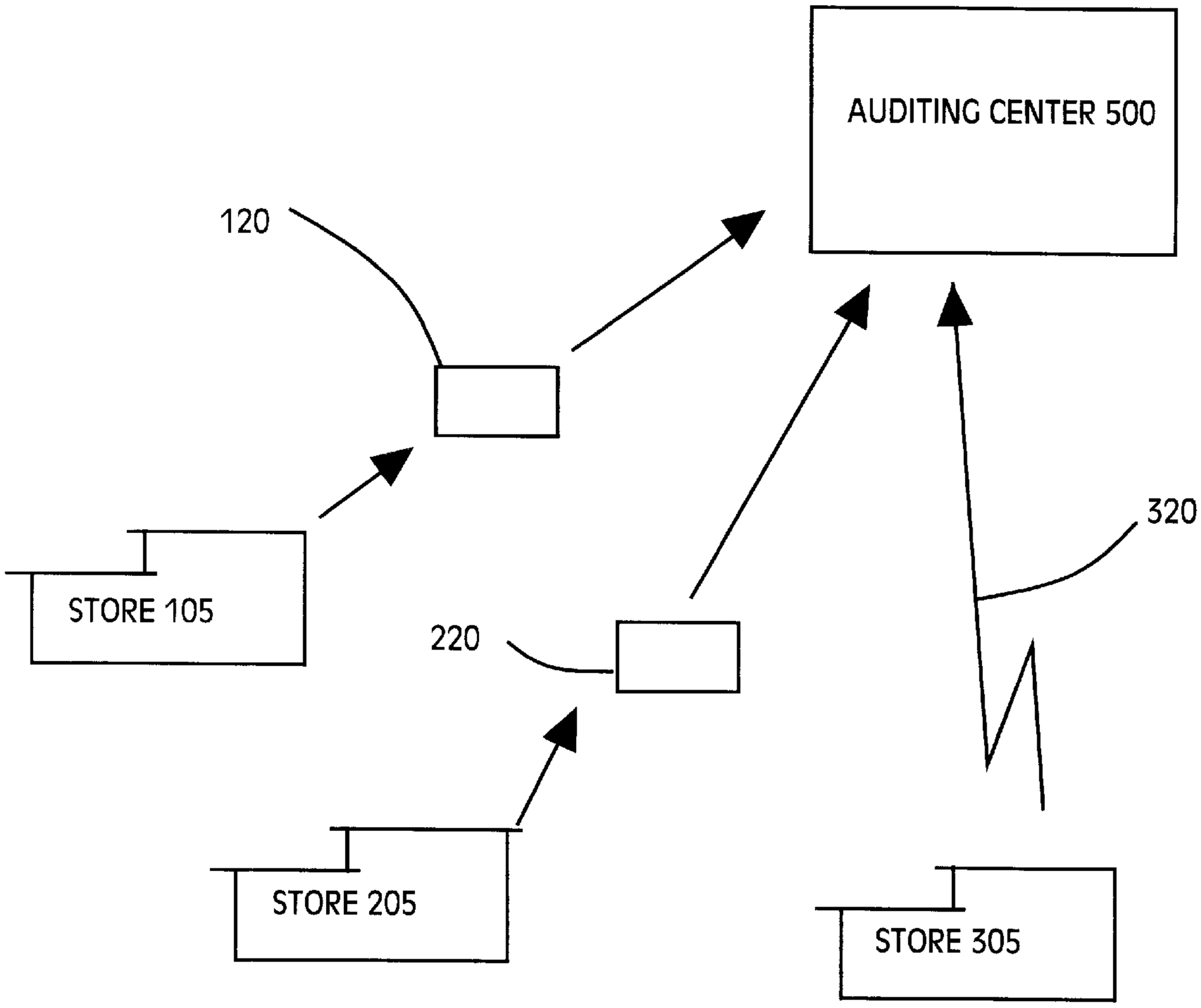

AUDITING CENTER 500
120
320
STORE 105
220
STORE 205
STORE 305

Fig. 1

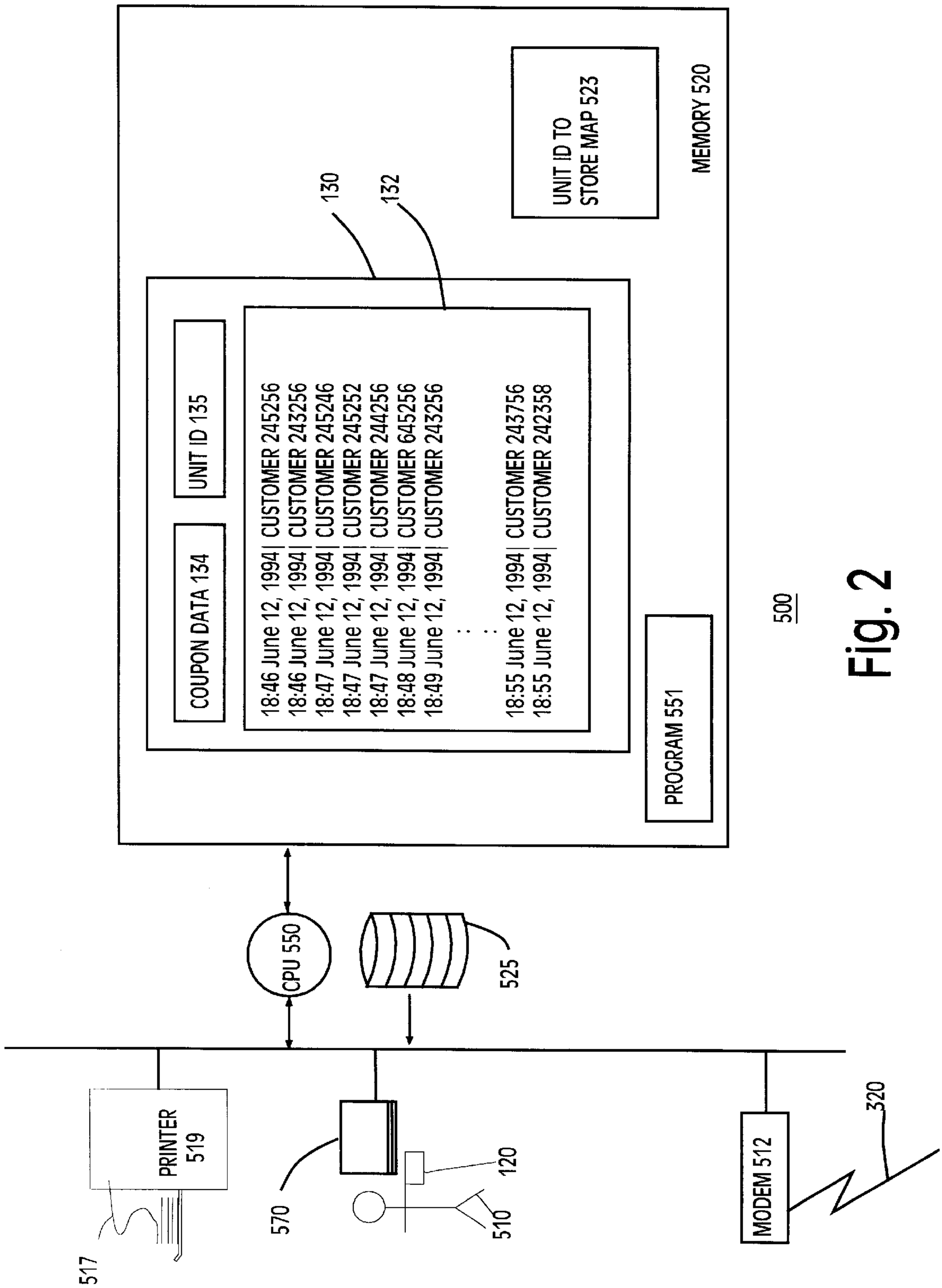

MEMORY 520
UNIT ID TO STORE MAP 523
130
132
COUPON DATA 134
UNIT ID 135
18:46 June 12, 1994| CUSTOMER 245256
18:46 June 12, 1994| CUSTOMER 243256
18:47 June 12, 1994| CUSTOMER 245246
18:47 June 12, 1994| CUSTOMER 245252
18:47 June 12, 1994| CUSTOMER 244256
18:48 June 12, 1994| CUSTOMER 645256
18:49 June 12, 1994| CUSTOMER 243256
18:55 June 12, 1994| CUSTOMER 243756
18:55 June 12, 1994| CUSTOMER 242358
PROGRAM 551
500
CPU 550
525
PRINTER 519
517
570
120
510
MODEM 512
320

Fig. 2

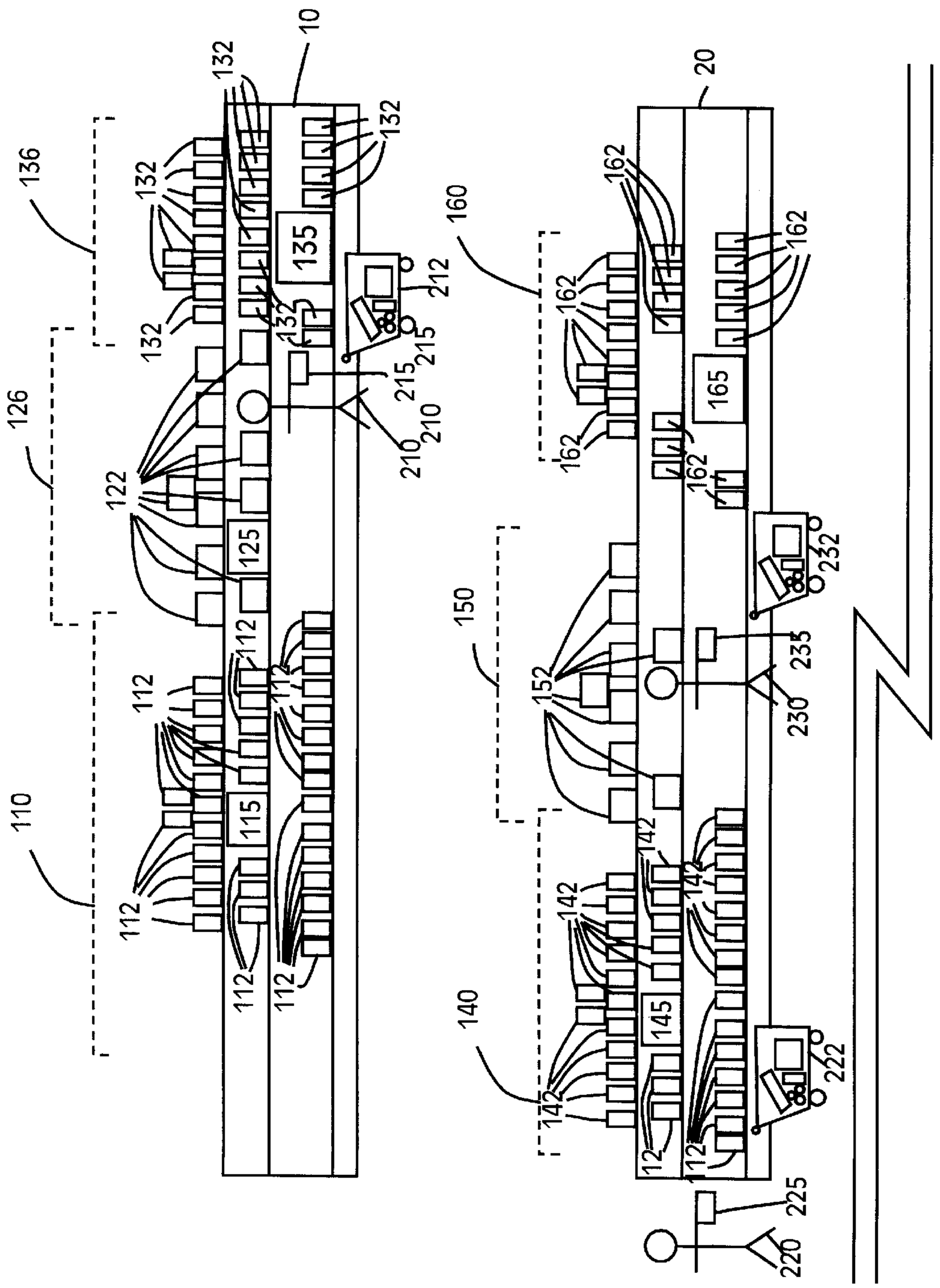

110
112
115
125
126
122
132
135
136
210
212
215
140
142
145
150
152
160
162
165
220
222
225
230
232
235

Fig. 3A

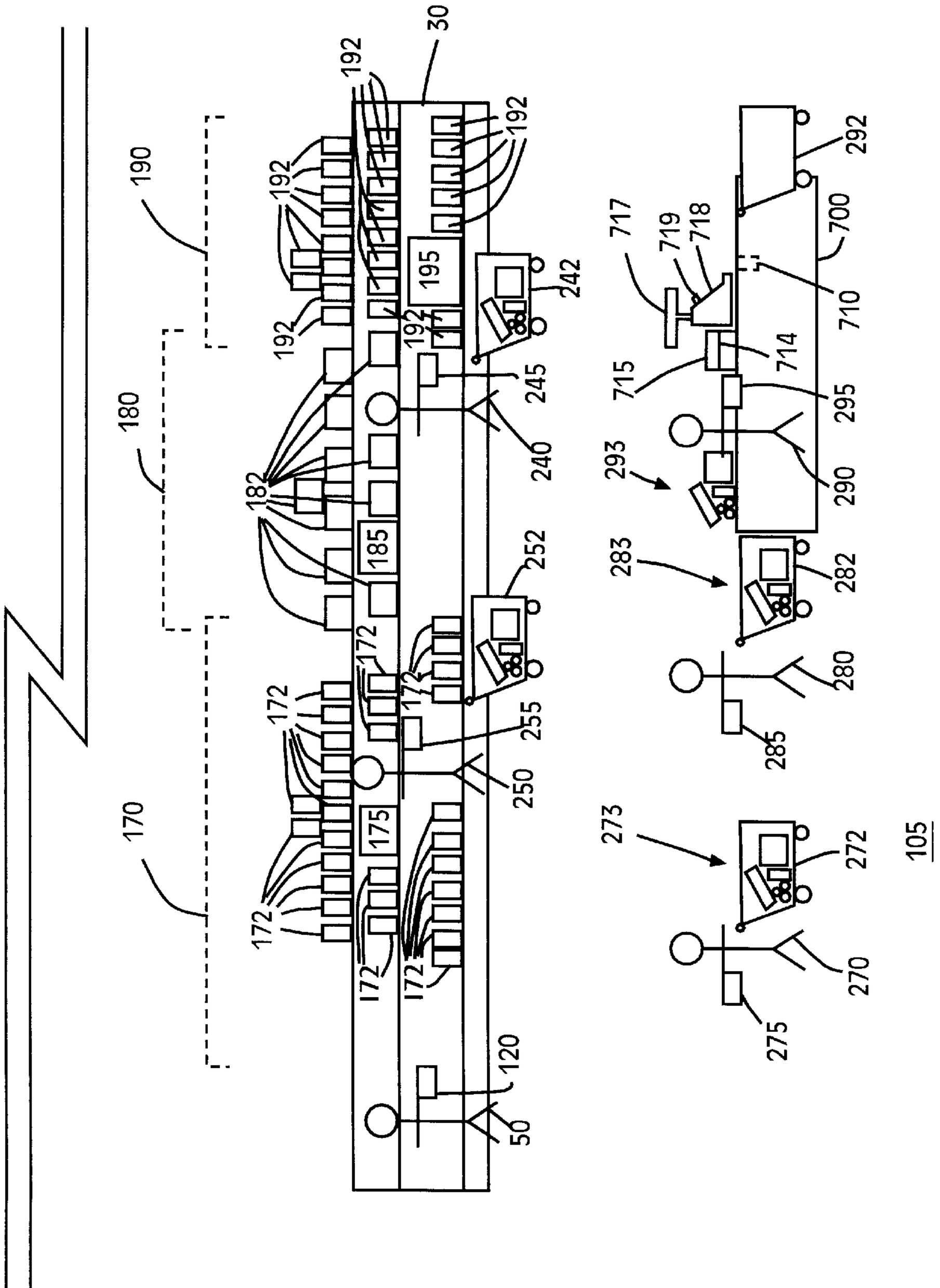

105
170
172
175
120
50
180
182
185
190
192
195
240
242
245
250
252
255
273
272
270
275
283
282
280
285
293
290
295
714
715
717
718
719
700
710
292

Fig. 3B

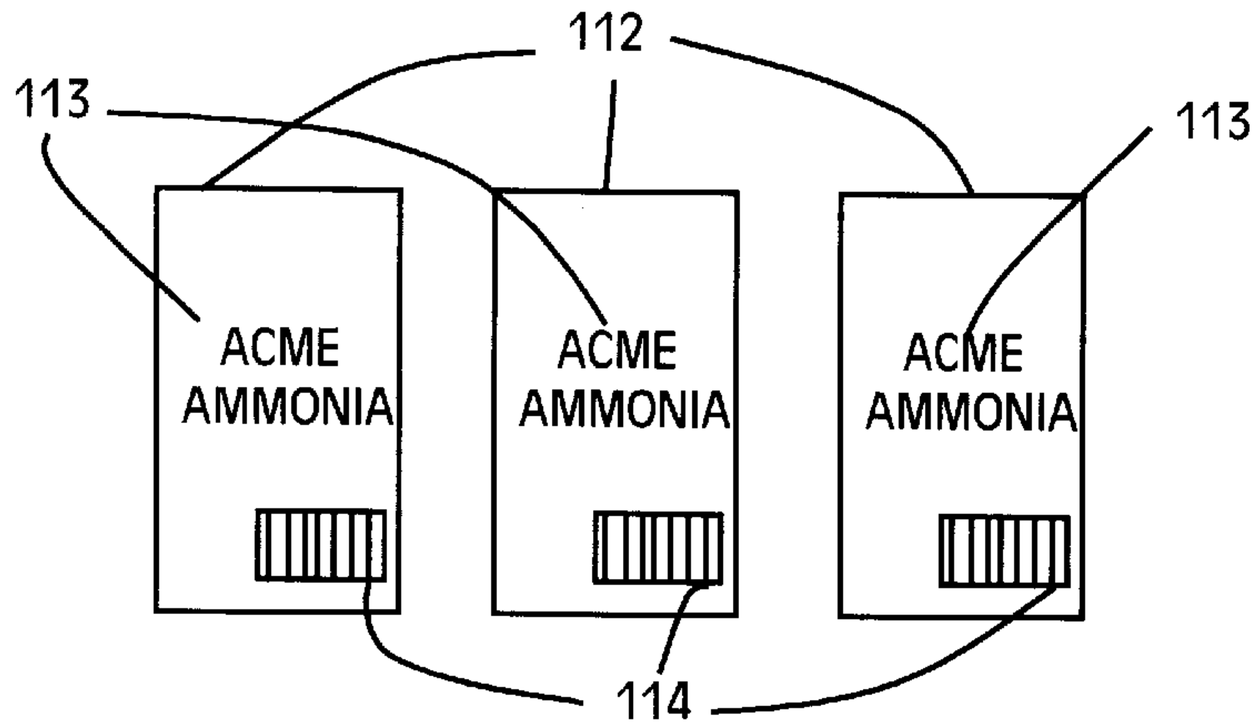


Fig. 4A

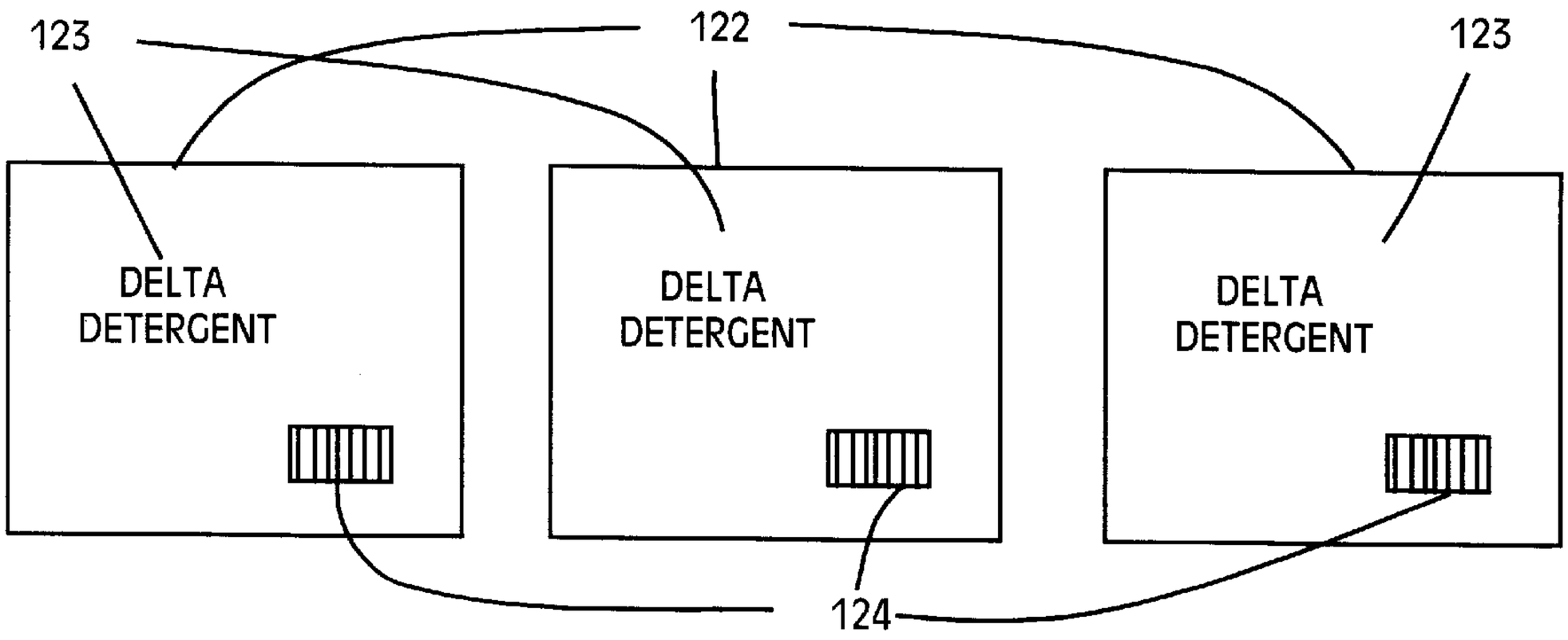


Fig. 4B

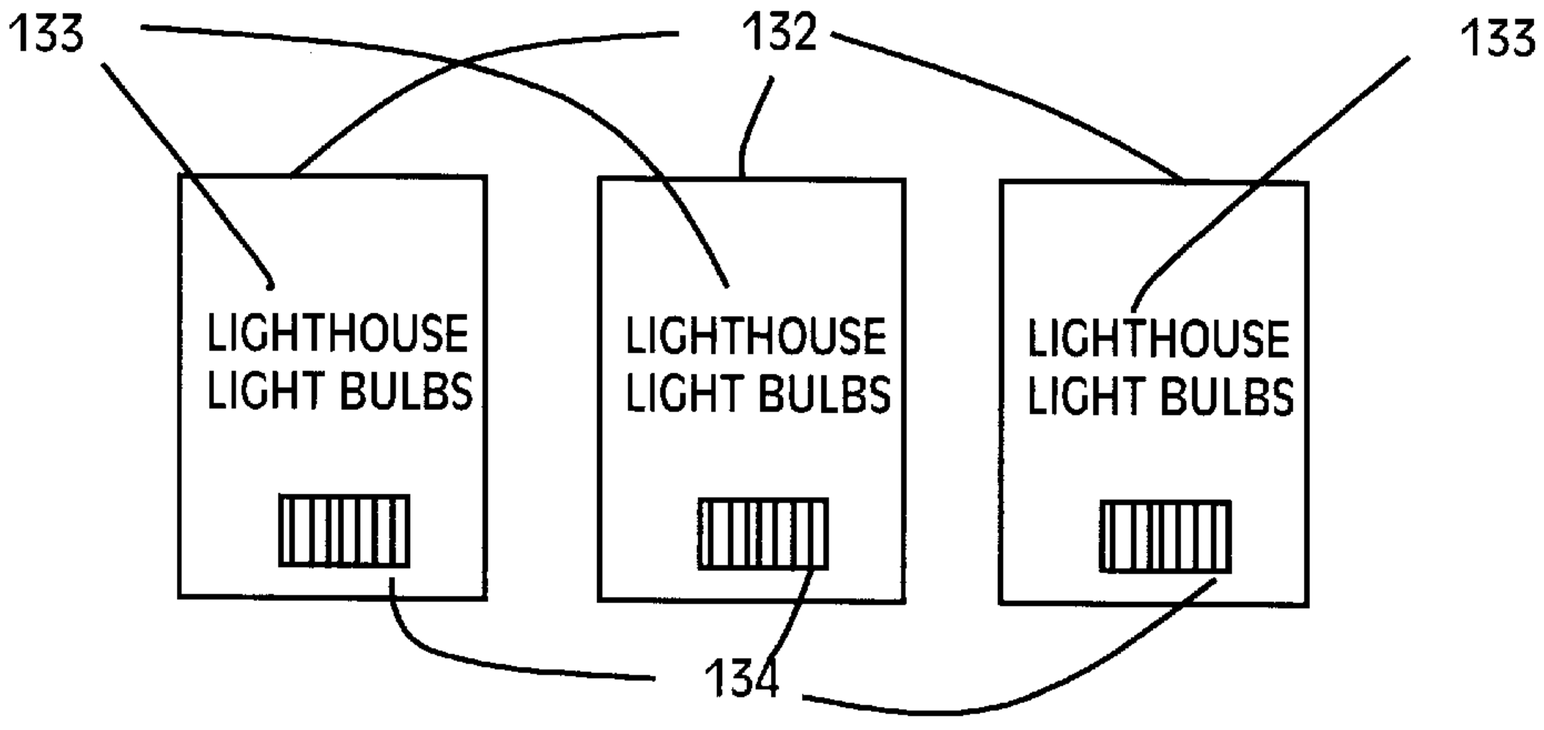


Fig. 4C

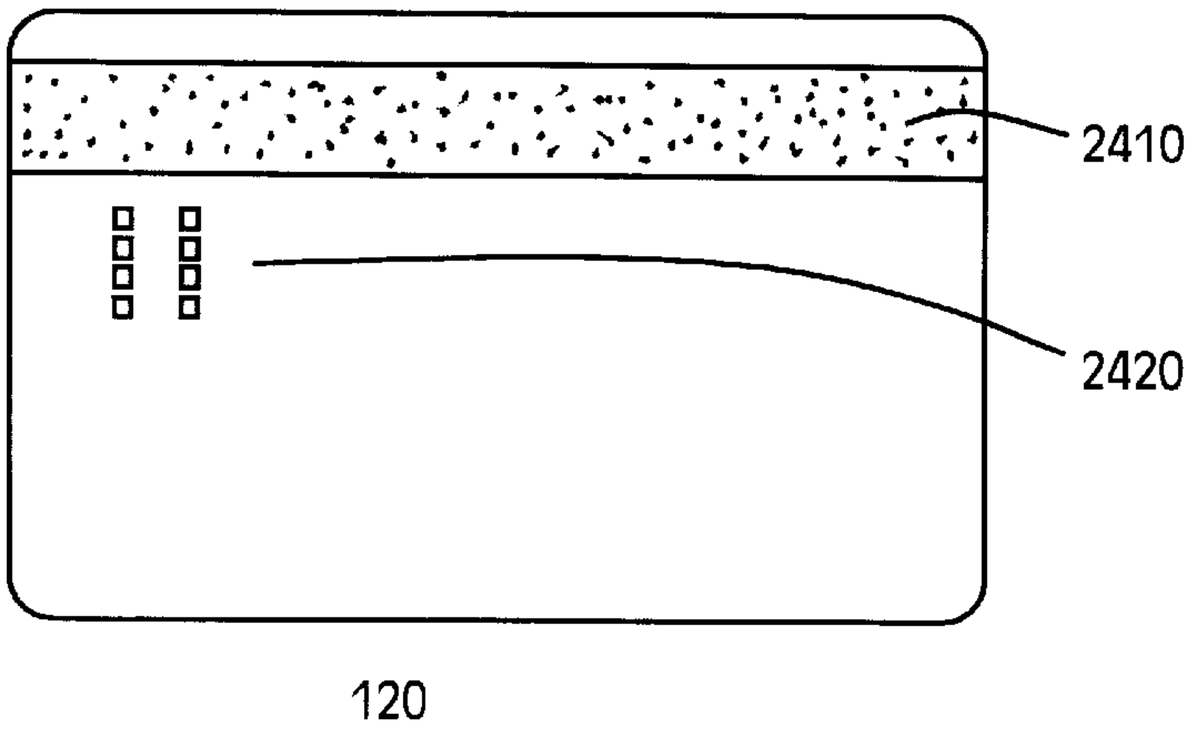


Fig. 5A

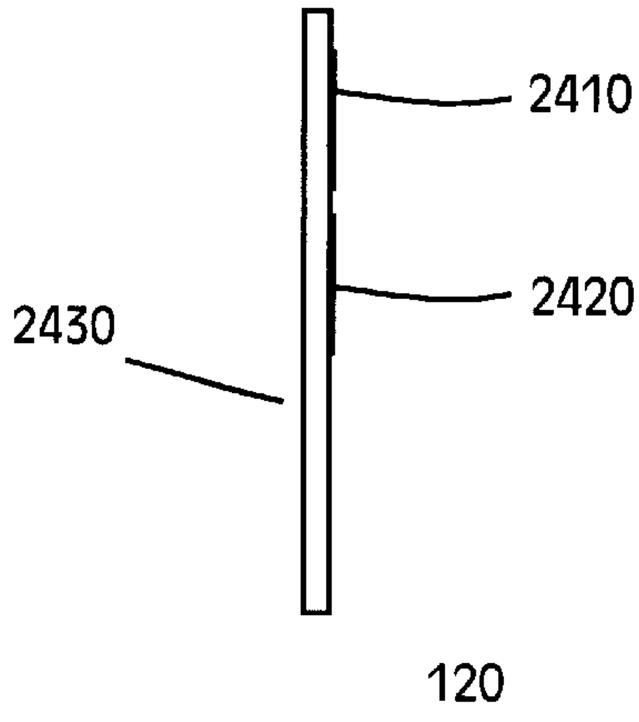


Fig. 5B

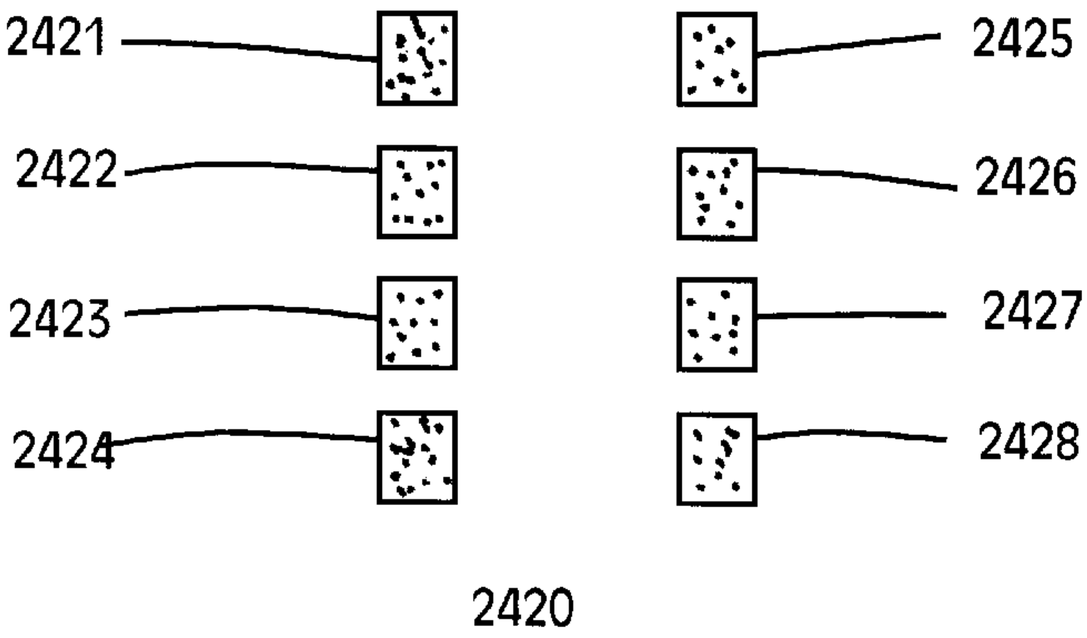


Fig. 5C

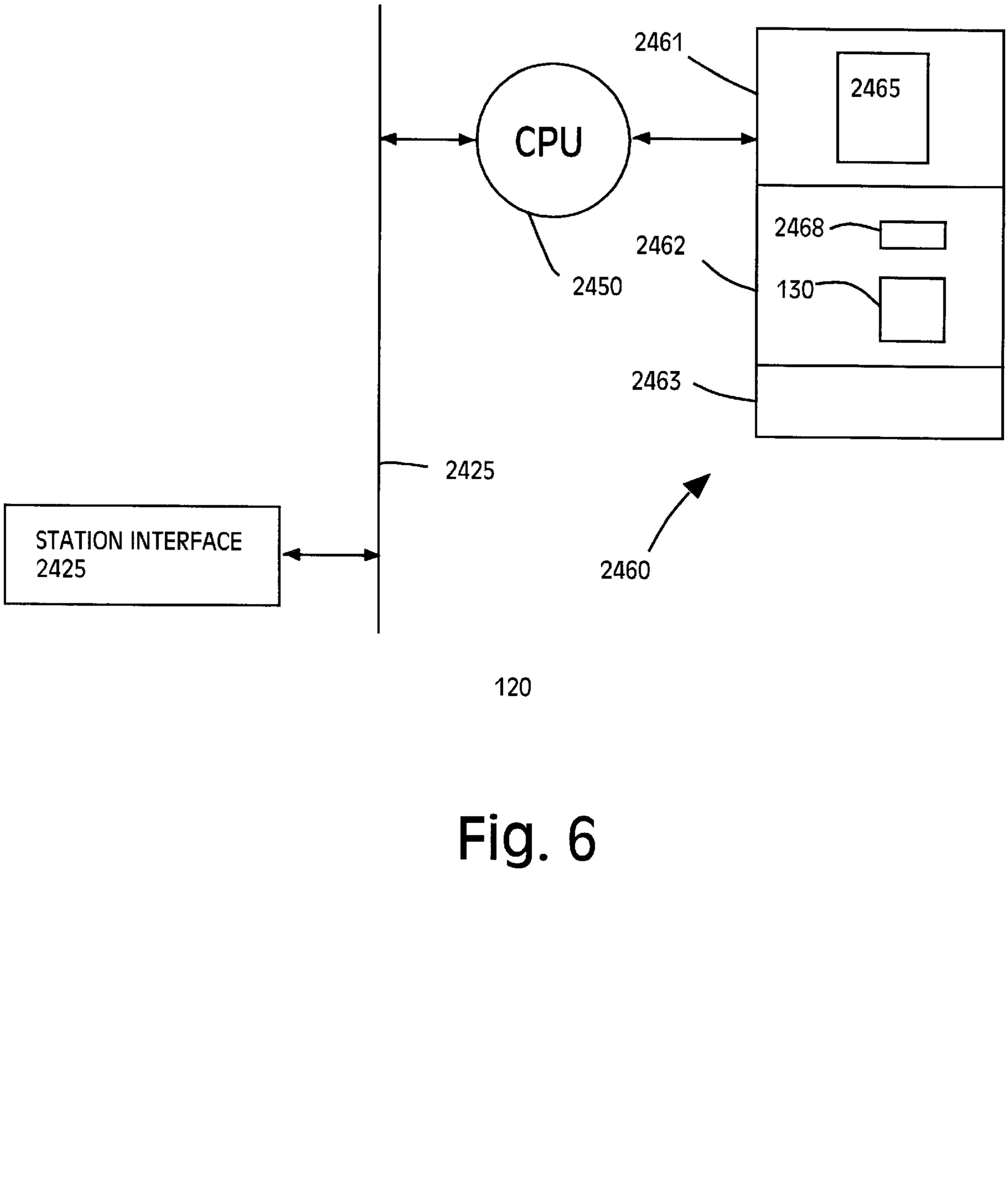

2461
2465
CPU
2468
2462
2450
130
2463
2425
STATION INTERFACE
2425
2460
120

Fig. 6

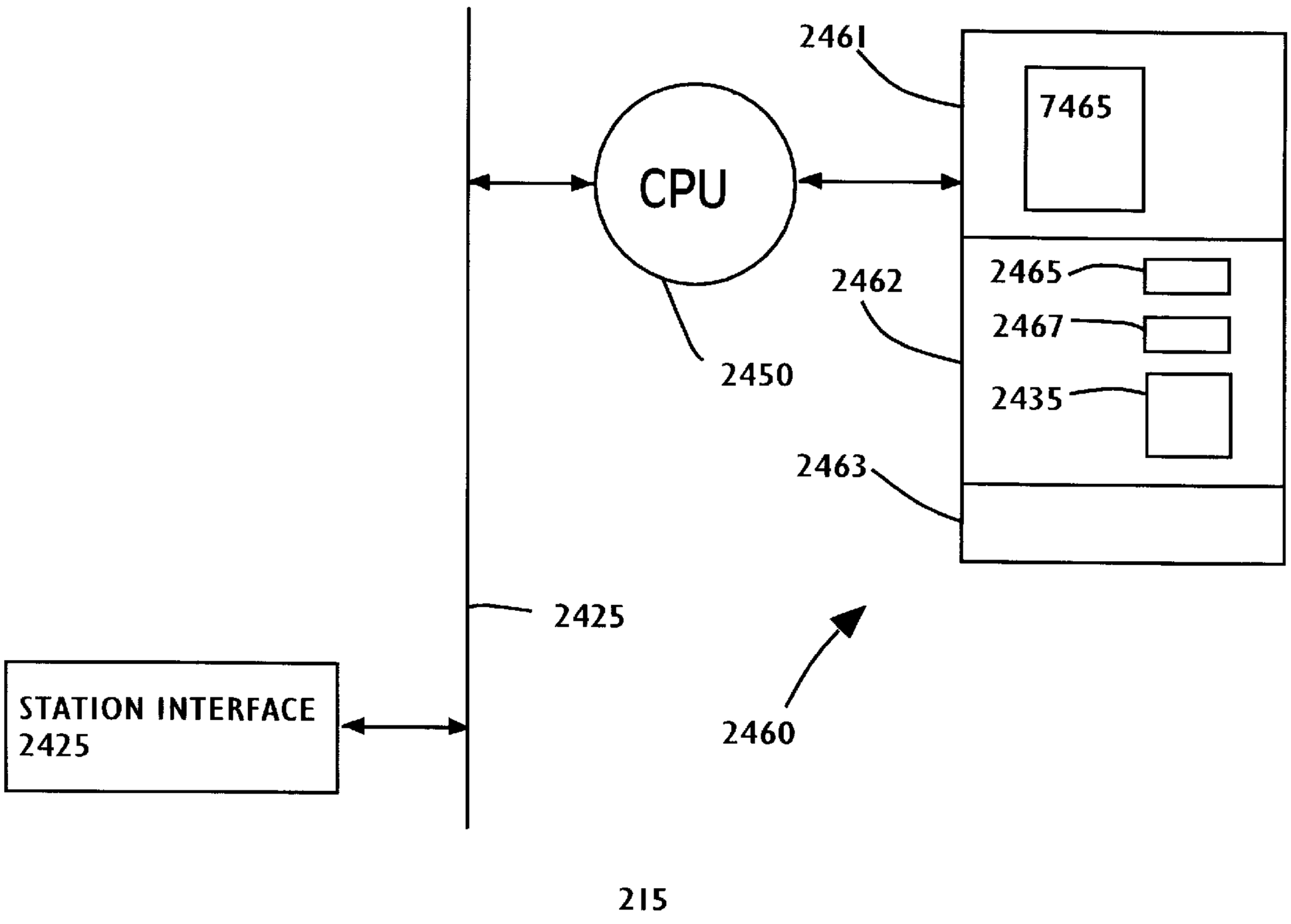

2461
7465
CPU
2465
2462
2467
2450
2435
2463
2425
2460
STATION INTERFACE
2425
215

Fig. 7

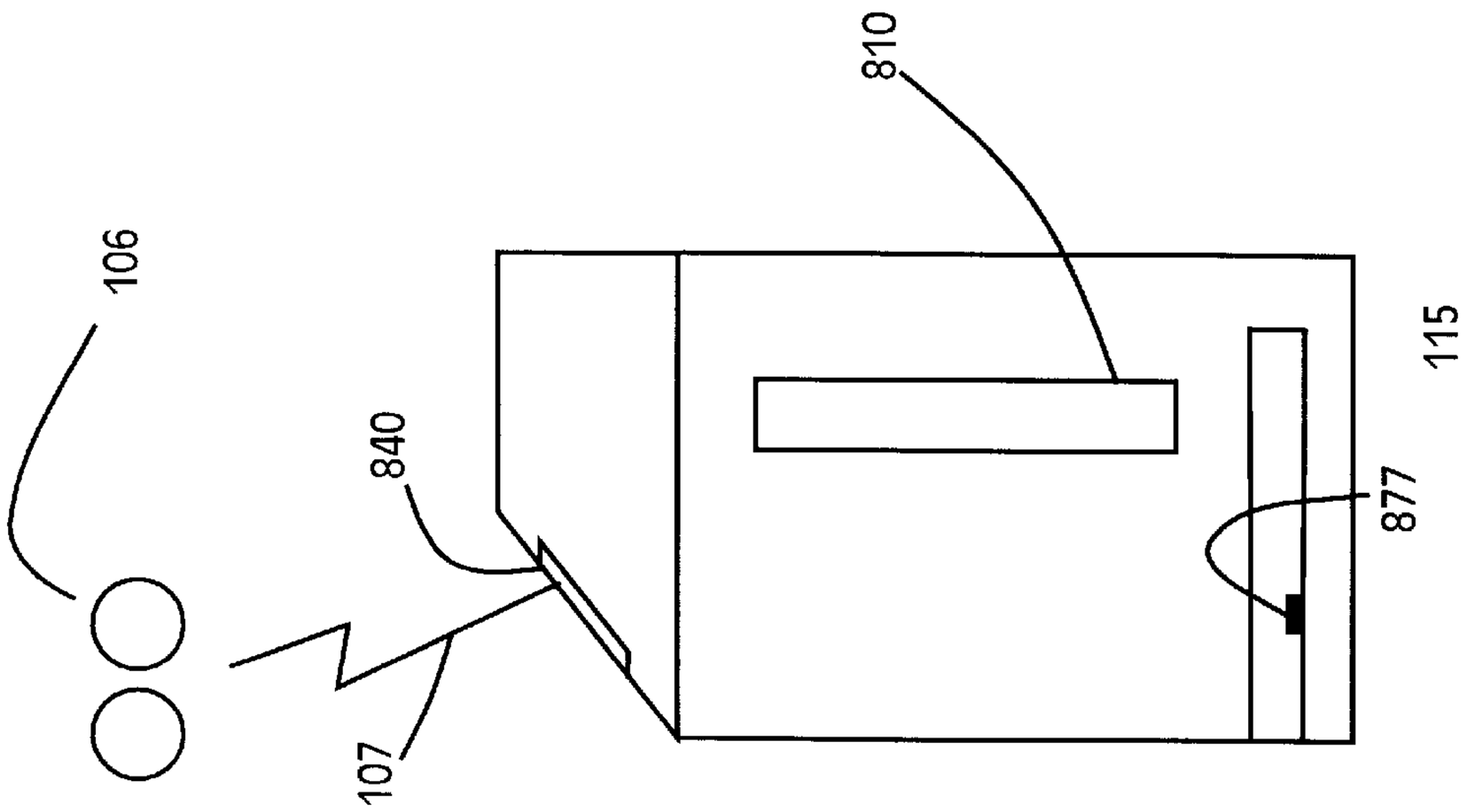


Fig. 8B

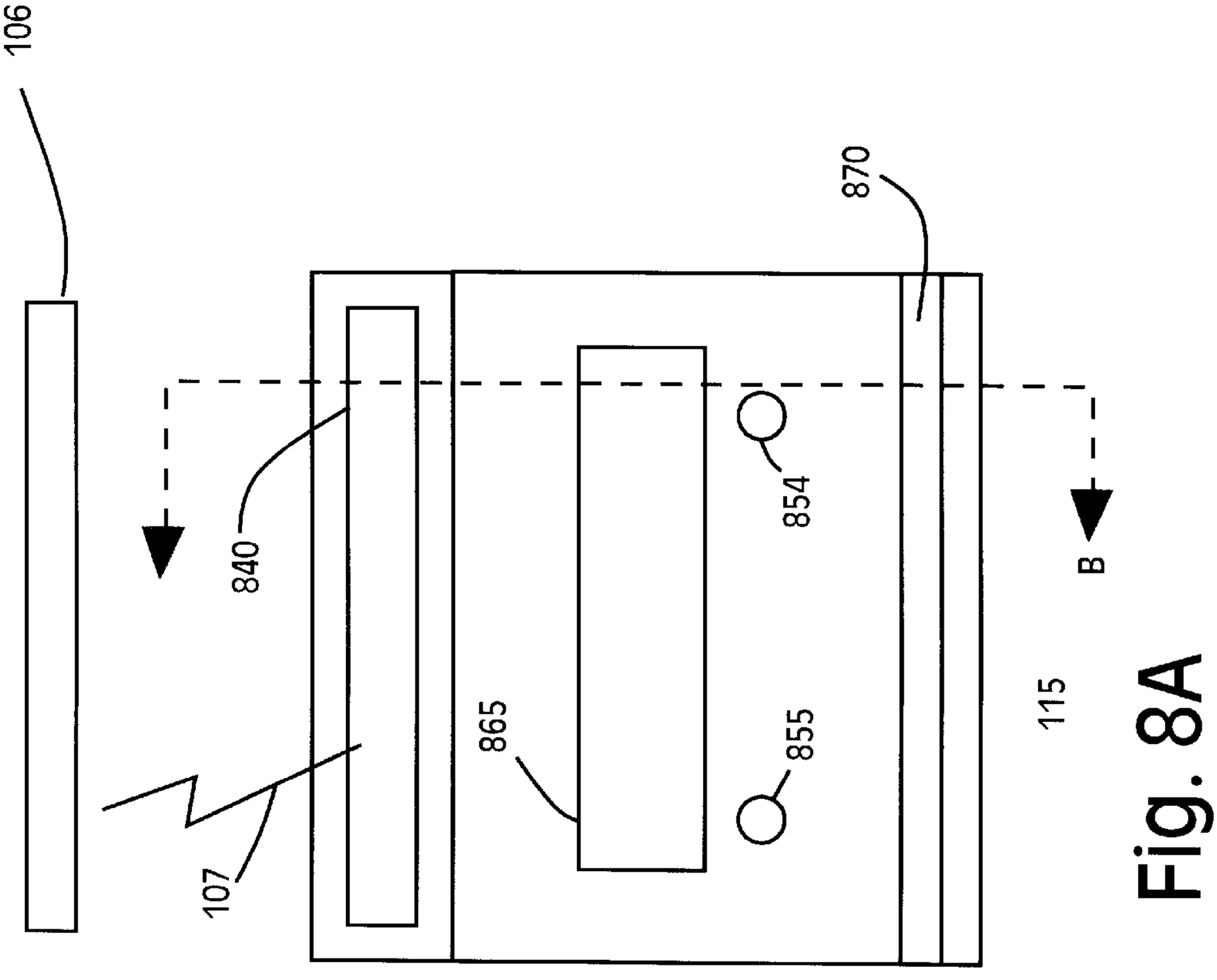


Fig. 8A

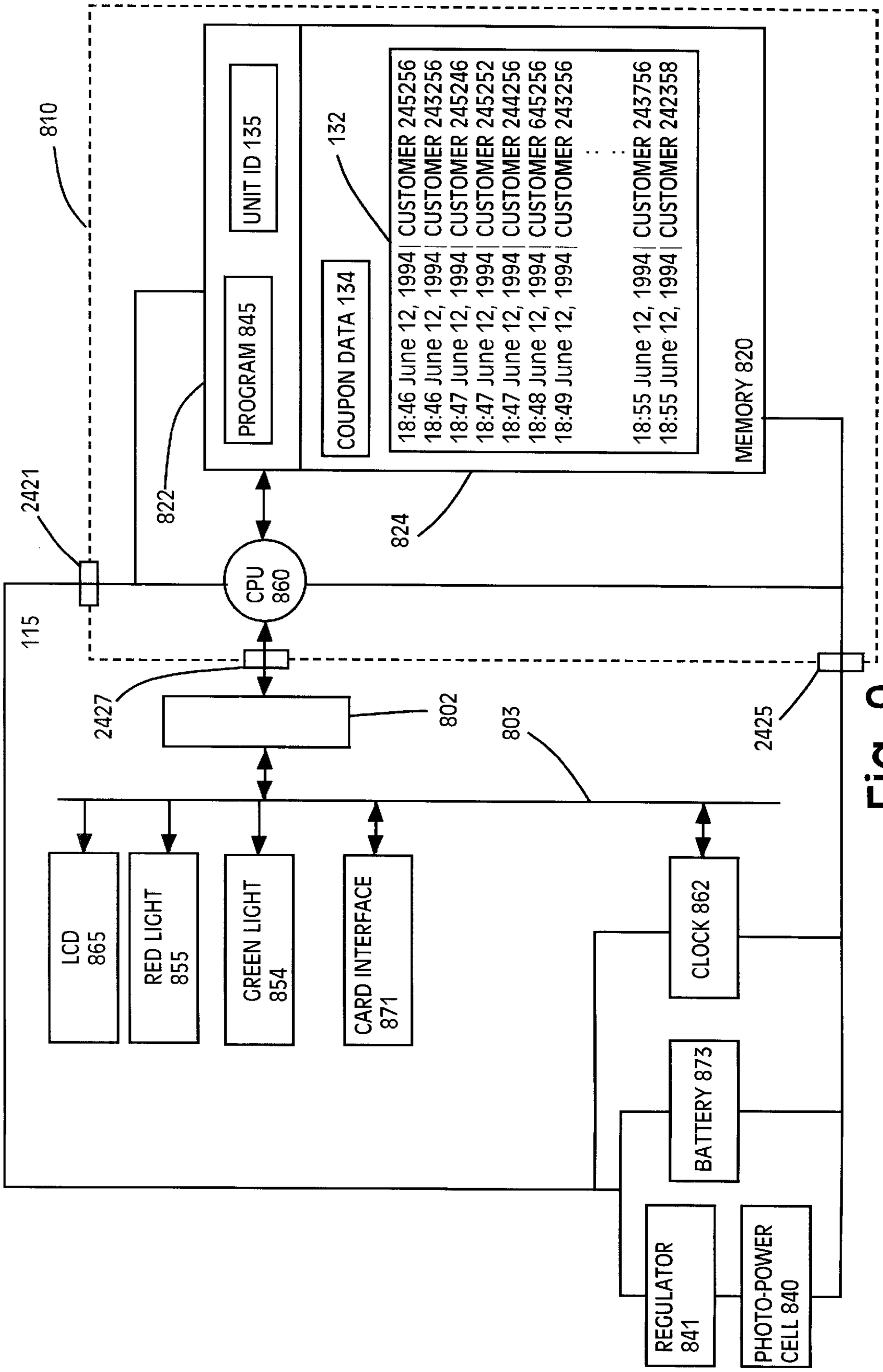

810
UNIT ID 135
132
PROGRAM 845
COUPON DATA 134
18:46 June 12, 1994 CUSTOMER 245256
18:46 June 12, 1994 CUSTOMER 243256
18:47 June 12, 1994 CUSTOMER 245246
18:47 June 12, 1994 CUSTOMER 245252
18:47 June 12, 1994 CUSTOMER 244256
18:48 June 12, 1994 CUSTOMER 645256
18:49 June 12, 1994 CUSTOMER 243256
18:55 June 12, 1994 CUSTOMER 243756
18:55 June 12, 1994 CUSTOMER 242358
MEMORY 820
822
824
2421
CPU 860
115
2427
802
803
2425
LCD 865
RED LIGHT 855
GREEN LIGHT 854
CARD INTERFACE 871
CLOCK 862
BATTERY 873
REGULATOR 841
PHOTO-POWER CELL 840

Fig. 9

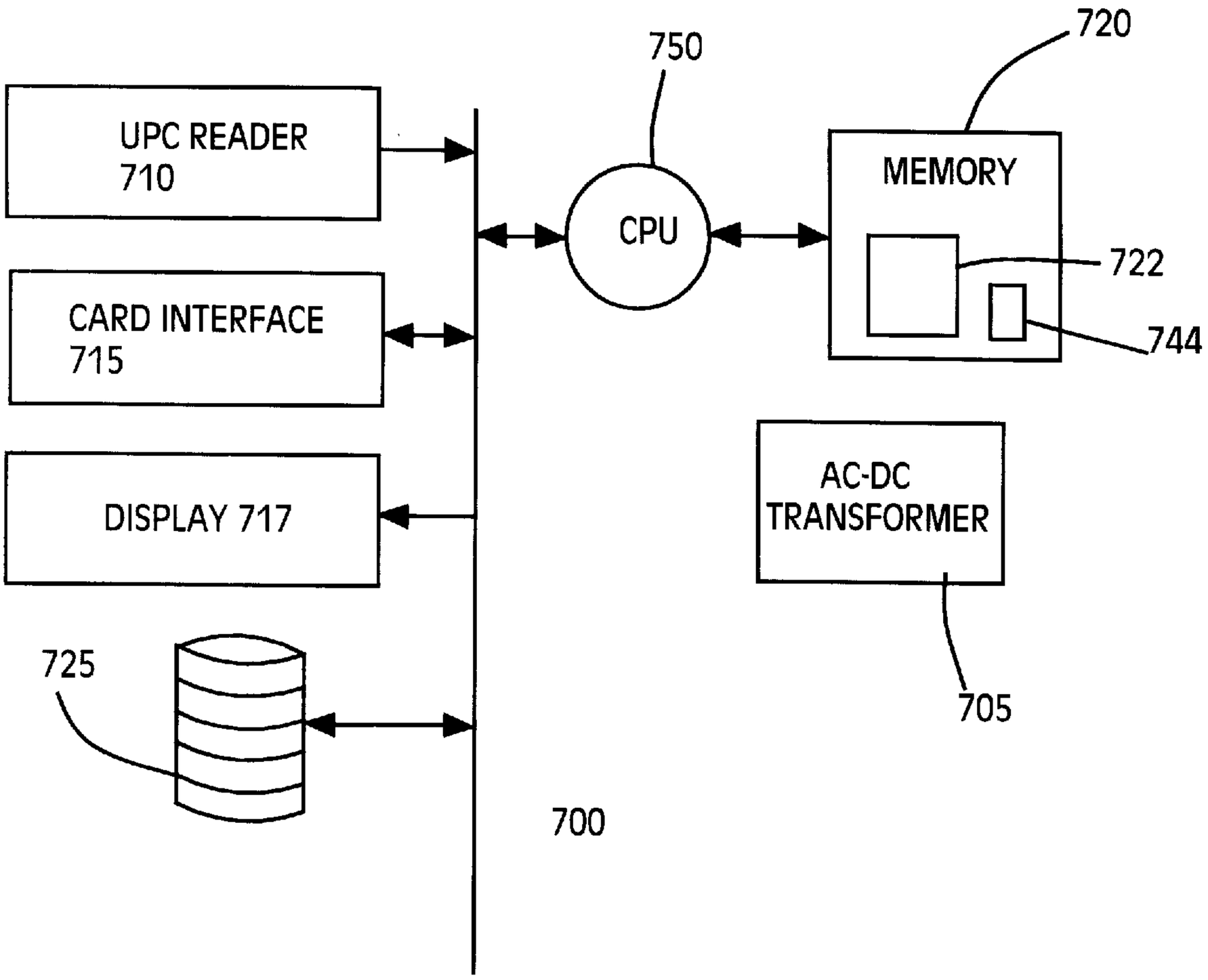

750
720
UPC READER
710
CPU
MEMORY
722
744
CARD INTERFACE
715
DISPLAY 717
AC-DC
TRANSFORMER
725
705
700

Fig. 10

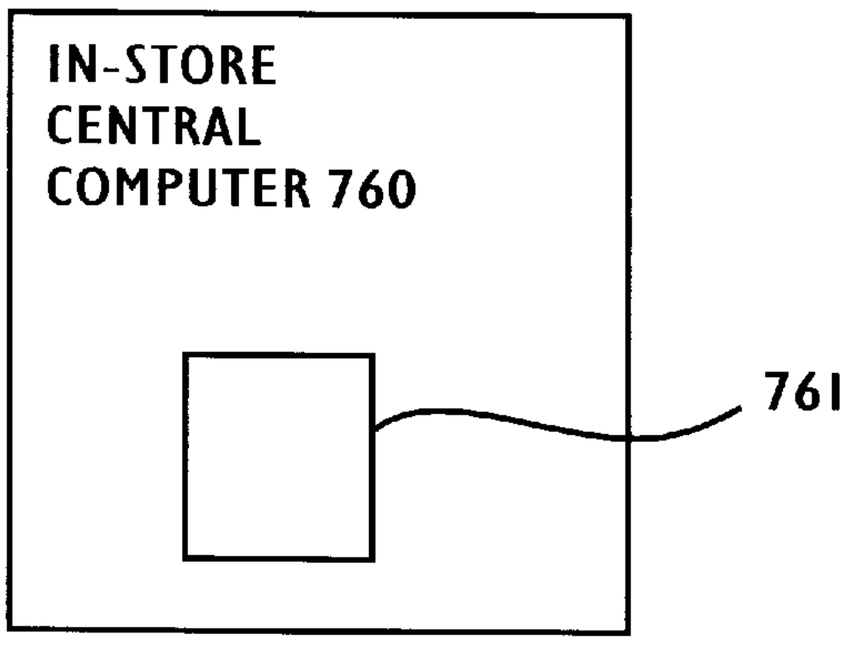

IN-STORE
CENTRAL
COMPUTER 760
761

Fig. 31

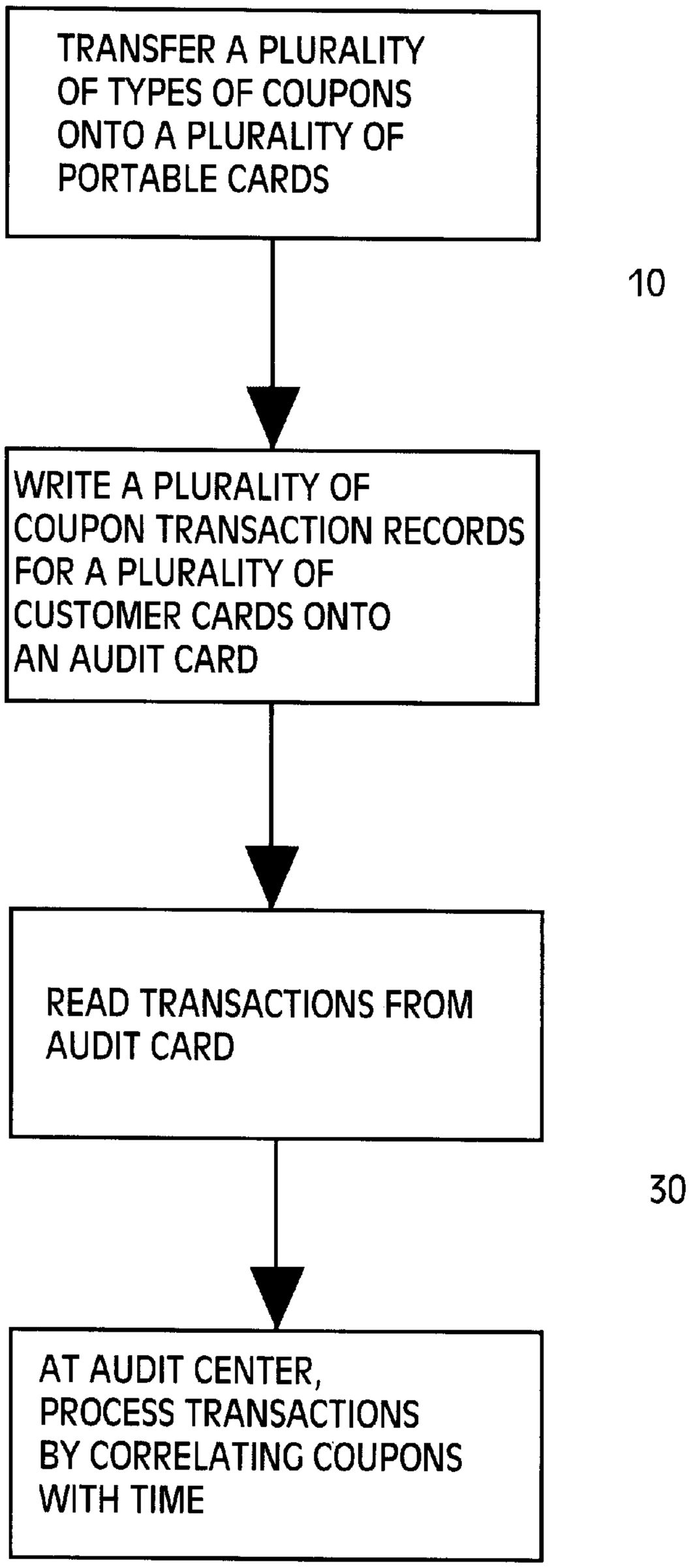

TRANSFER A PLURALITY OF TYPES OF COUPONS ONTO A PLURALITY OF PORTABLE CARDS
WRITE A PLURALITY OF COUPON TRANSACTION RECORDS FOR A PLURALITY OF CUSTOMER CARDS ONTO AN AUDIT CARD
READ TRANSACTIONS FROM AUDIT CARD
AT AUDIT CENTER, PROCESS TRANSACTIONS BY CORRELATING COUPONS WITH TIME
10
20
30
40

FIG. 11

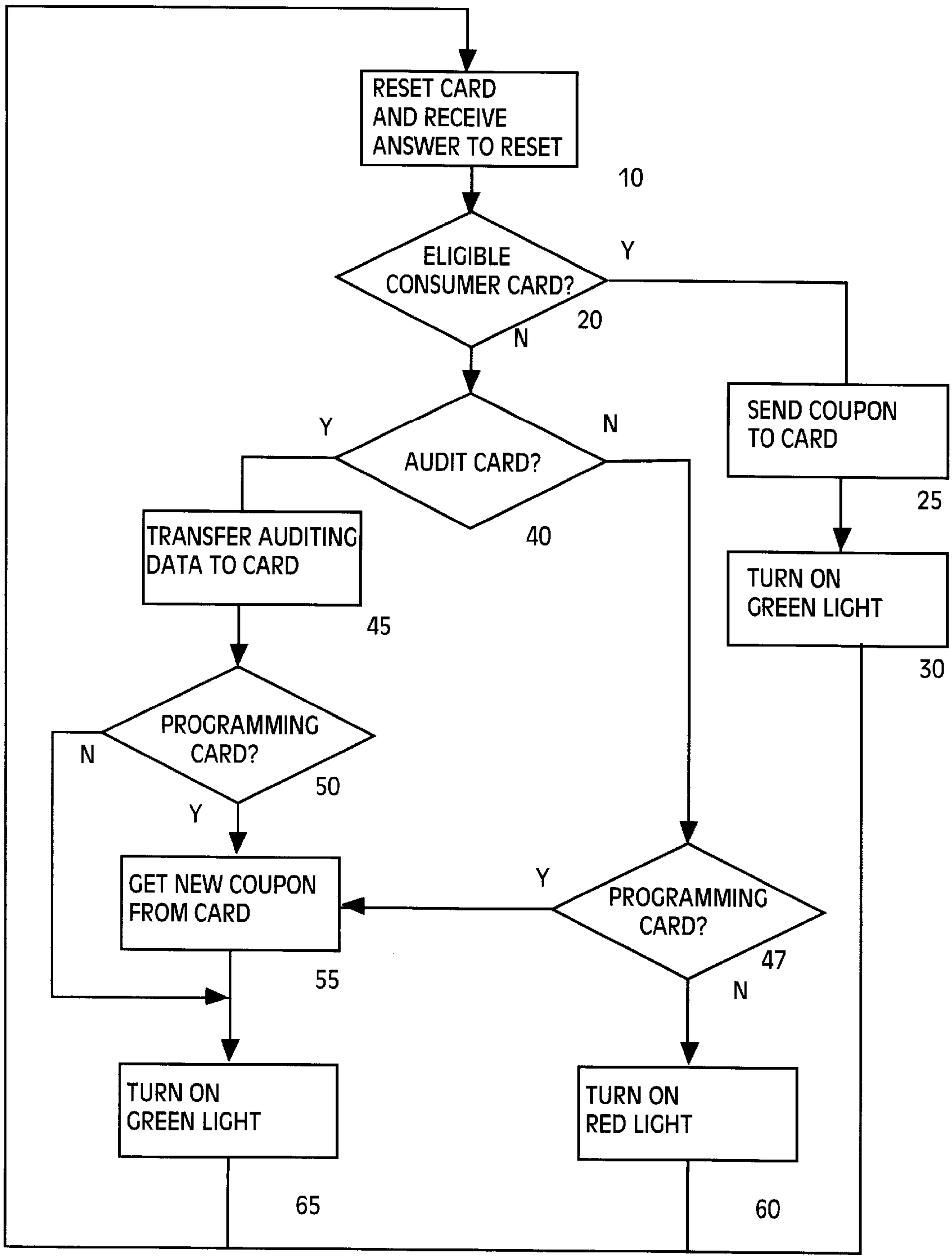

RESET CARD AND RECEIVE ANSWER TO RESET
10
ELIGIBLE CONSUMER CARD?
Y
20
N
SEND COUPON TO CARD
25
AUDIT CARD?
Y
N
40
TRANSFER AUDITING DATA TO CARD
45
TURN ON GREEN LIGHT
30
PROGRAMMING CARD?
N
50
Y
GET NEW COUPON FROM CARD
55
PROGRAMMING CARD?
Y
47
N
TURN ON GREEN LIGHT
65
TURN ON RED LIGHT
60

Fig. 12

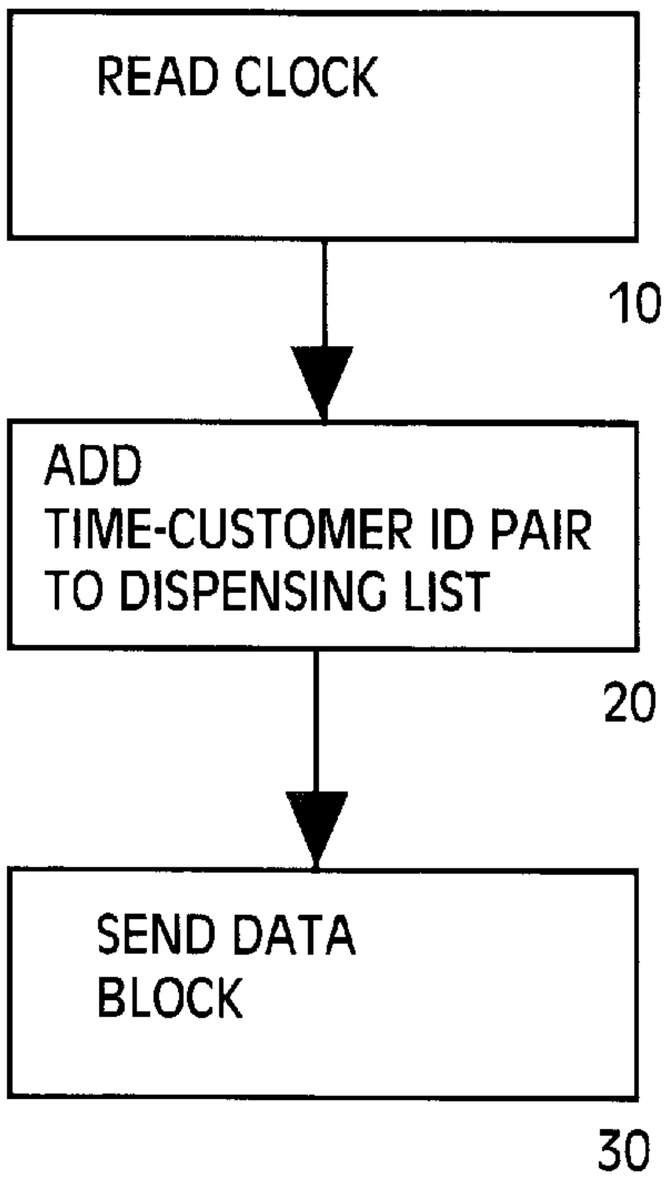


Fig. 13

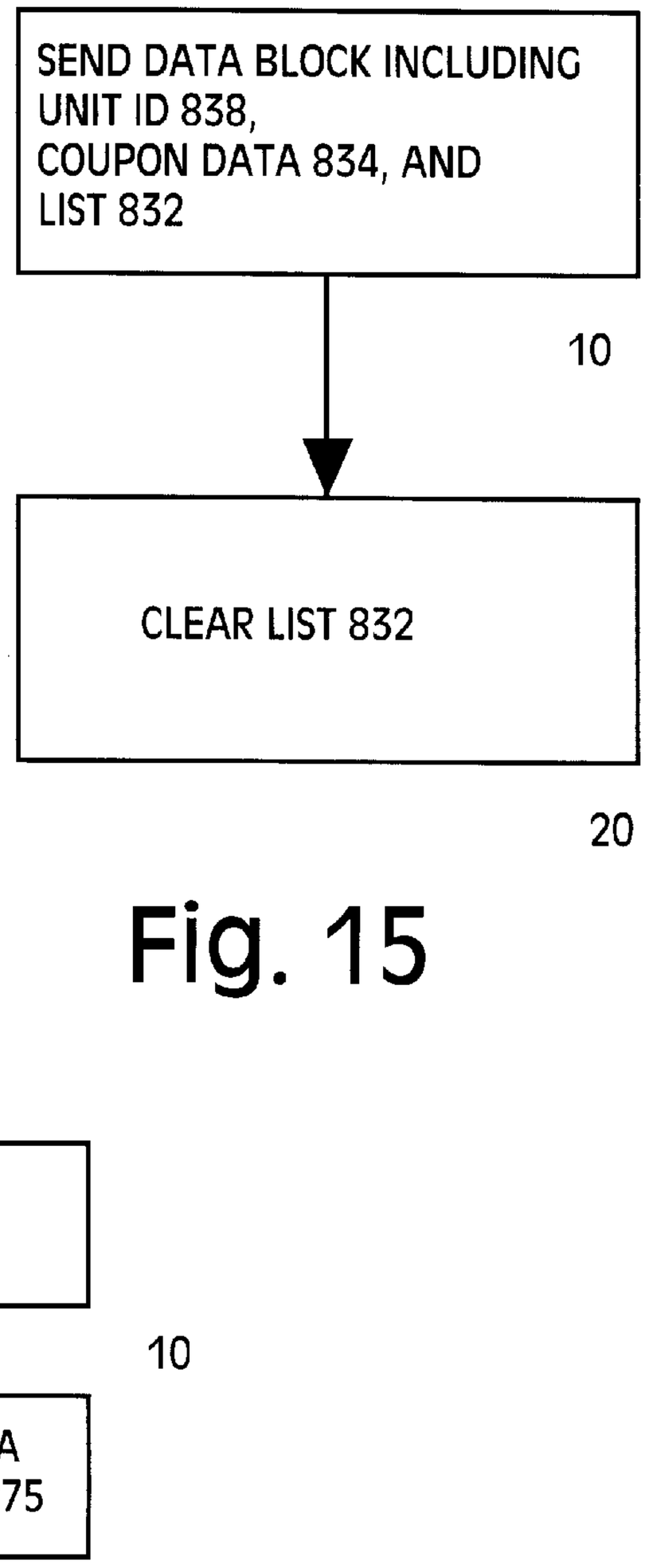


Fig. 15

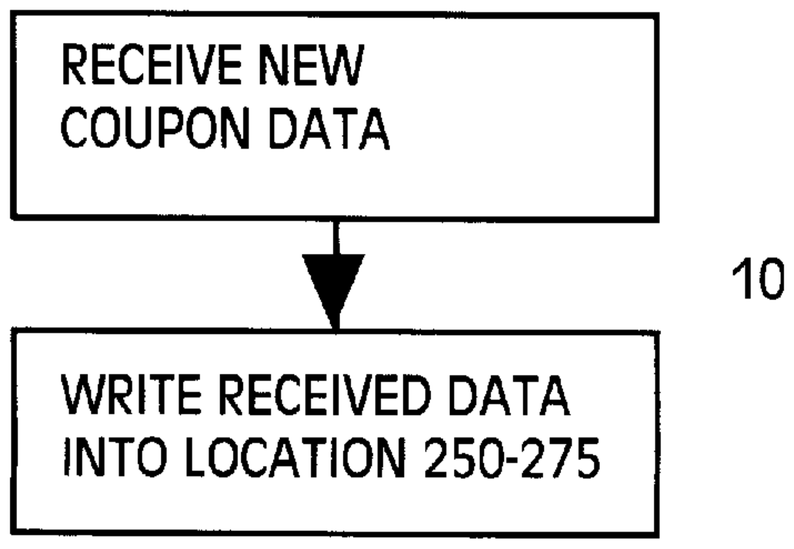


Fig. 16

30: 5 17031 268 45 8
5 17054 235 76 5

2435

Fig. 14A

30: 5 17031 268 45 8
5 17054 235 76 5
5 17075 278 30 7

2435

Fig. 14B

250: 5 17075 278 30 7

COUPON DATA 134
IN MEMORY 820

Fig. 17A

250: 5 17054 235 76 5

COUPON DATA 134
IN MEMORY 820

Fig. 17B

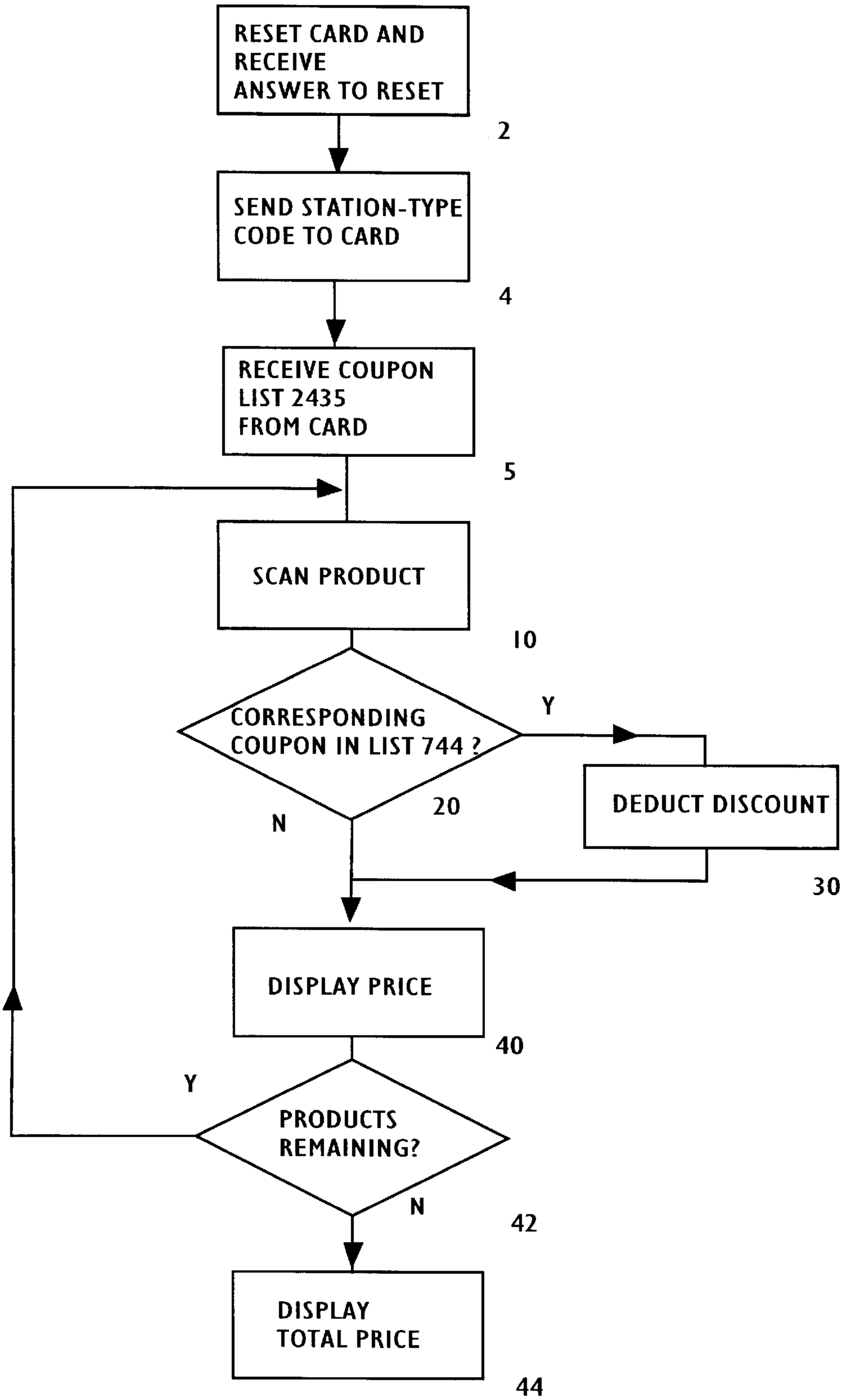

RESET CARD AND RECEIVE ANSWER TO RESET
2
SEND STATION-TYPE CODE TO CARD
4
RECEIVE COUPON LIST 2435 FROM CARD
5
SCAN PRODUCT
10
CORRESPONDING COUPON IN LIST 744 ?
Y
DEDUCT DISCOUNT
20
N
30
DISPLAY PRICE
40
Y
PRODUCTS REMAINING?
N
42
DISPLAY TOTAL PRICE
44

Fig. 18

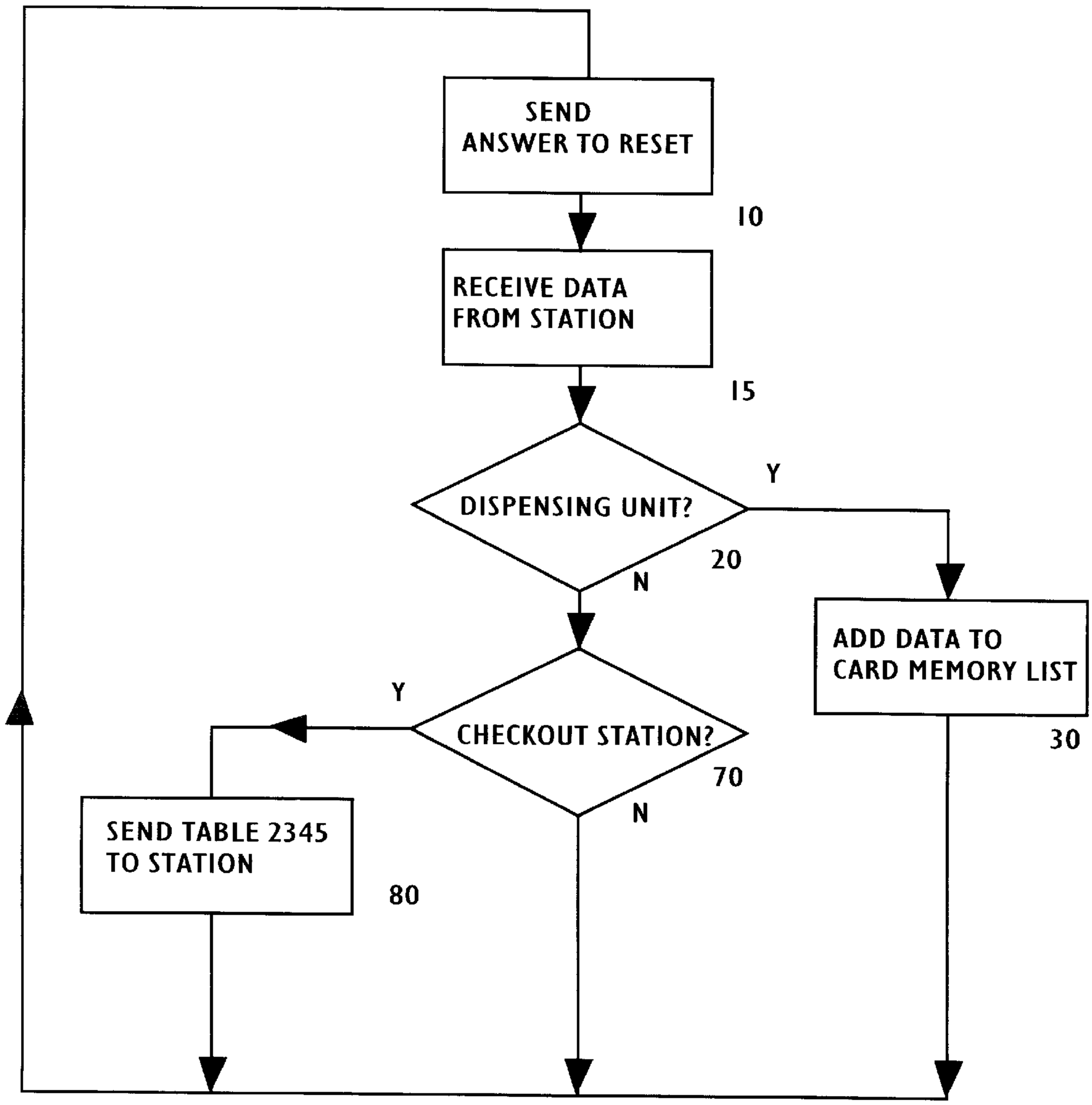

SEND
ANSWER TO RESET
10
RECEIVE DATA
FROM STATION
15
DISPENSING UNIT?
Y
20
N
ADD DATA TO
CARD MEMORY LIST
30
CHECKOUT STATION?
Y
70
N
SEND TABLE 2345
TO STATION
80

Fig. 19

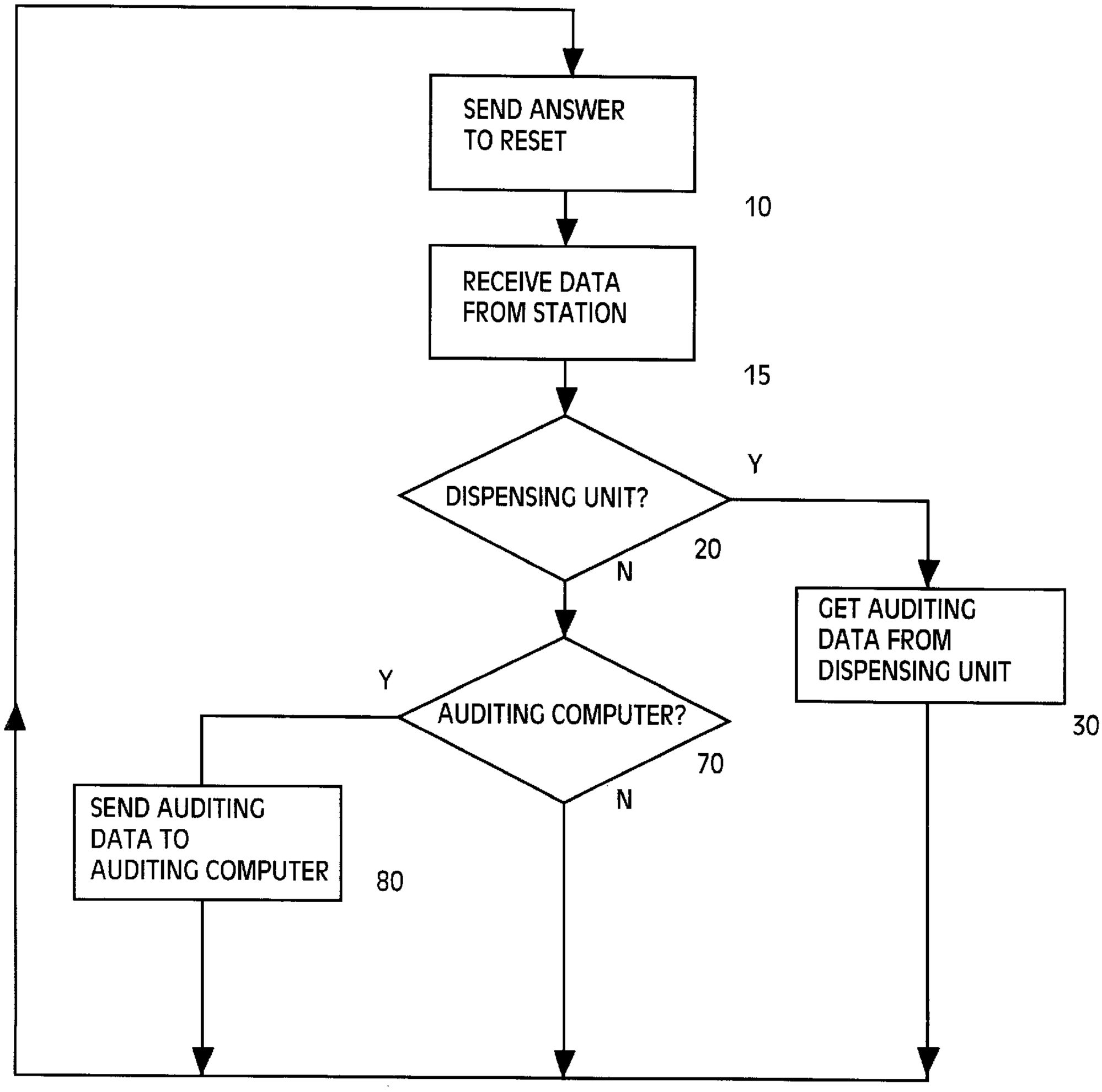

SEND ANSWER TO RESET
10
RECEIVE DATA FROM STATION
15
DISPENSING UNIT?
Y
20
N
GET AUDITING DATA FROM DISPENSING UNIT
30
AUDITING COMPUTER?
Y
70
N
SEND AUDITING DATA TO AUDITING COMPUTER
80

Fig. 20

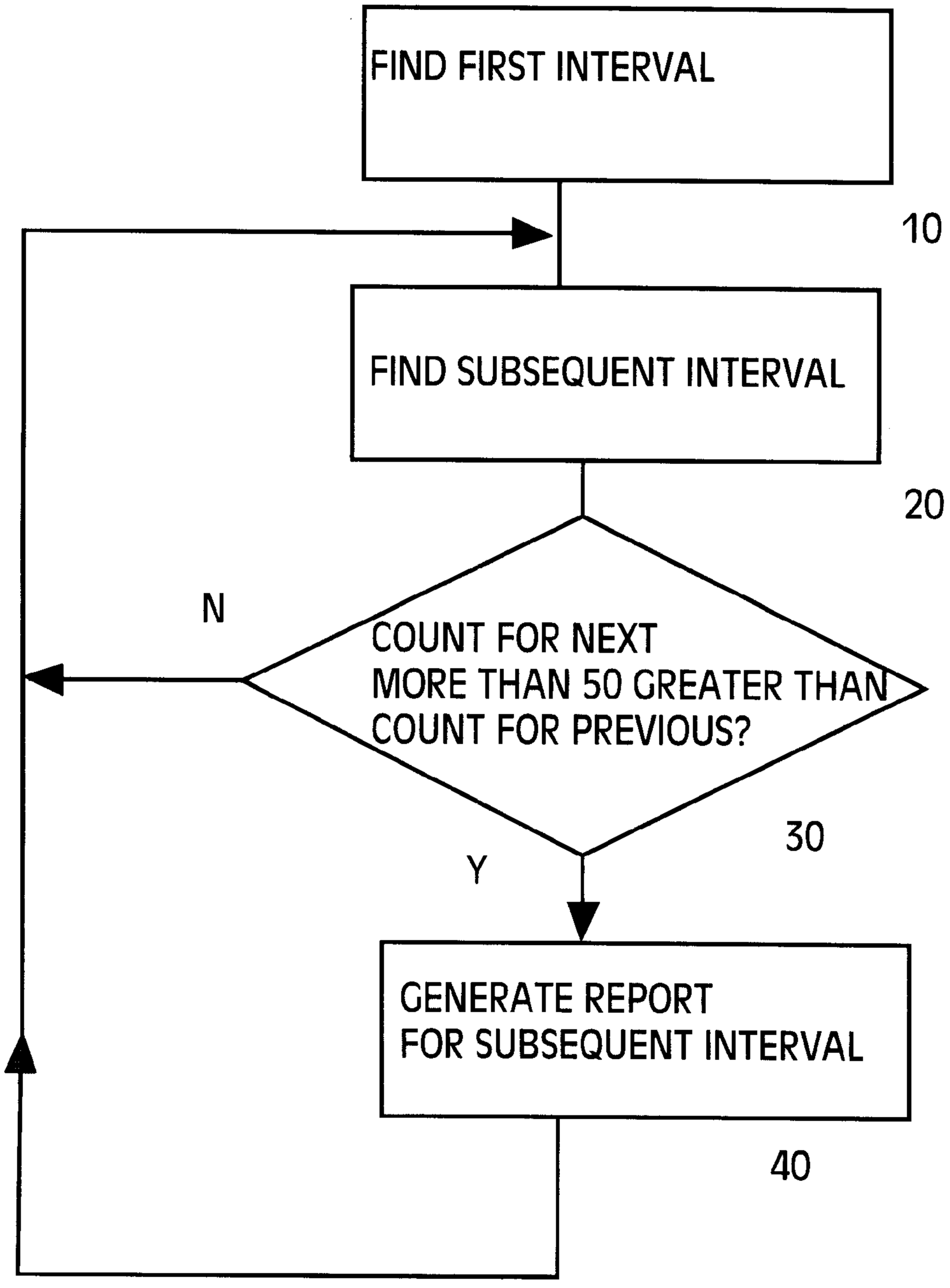

FIND FIRST INTERVAL
10
FIND SUBSEQUENT INTERVAL
20
N
COUNT FOR NEXT
MORE THAN 50 GREATER THAN
COUNT FOR PREVIOUS?
30
Y
GENERATE REPORT
FOR SUBSEQUENT INTERVAL
40

Fig. 21

517

THE FOLLOWING COUPONS WERE DISPENSED AT
ONE DISPENSER DURING A SHORT PERIOD OF TIME IN STORE 34921:

COUPON	CUSTOMER	TIME
500034300760	133578983	December 3, 1994; 22:13
500034300760	133578983	December 3, 1994; 22:13
500034300760	133578983	December 3, 1994; 22:13
500034300760	133578956	December 3, 1994; 22:14
500034300760	133578957	December 3, 1994; 22:14
500034300760	133578958	December 3, 1994; 22:14
500034300760	133578959	December 3, 1994; 22:14
500034300760	133578961	December 3, 1994; 22:14
500034300760	133578963	December 3, 1994; 22:14
500034300760	133578964	December 3, 1994; 22:15
500034300760	133578983	December 3, 1994; 22:15
500034300760	133578965	December 3, 1994; 22:16
500034300760	133578945	December 3, 1994; 22:16
500034300760	133578933	December 3, 1994; 22:17
500034300760	133578932	December 3, 1994; 22:17
500034300760	133578926	December 3, 1994; 22:17
500034300760	133578936	December 3, 1994; 22:17
500034300760	133578924	December 3, 1994; 22:17
500034300760	133578906	December 3, 1994; 22:17
500034300760	133578334	December 3, 1994; 22:17
	⋮	
500034300760	133578901	December 3, 1994; 22:19
500034300760	133578923	December 3, 1994; 22:19
500034300760	133578934	December 3, 1994; 22:19
500034300760	133578905	December 3, 1994; 22:20
500034300760	133578912	December 3, 1994; 22:20

Fig. 22

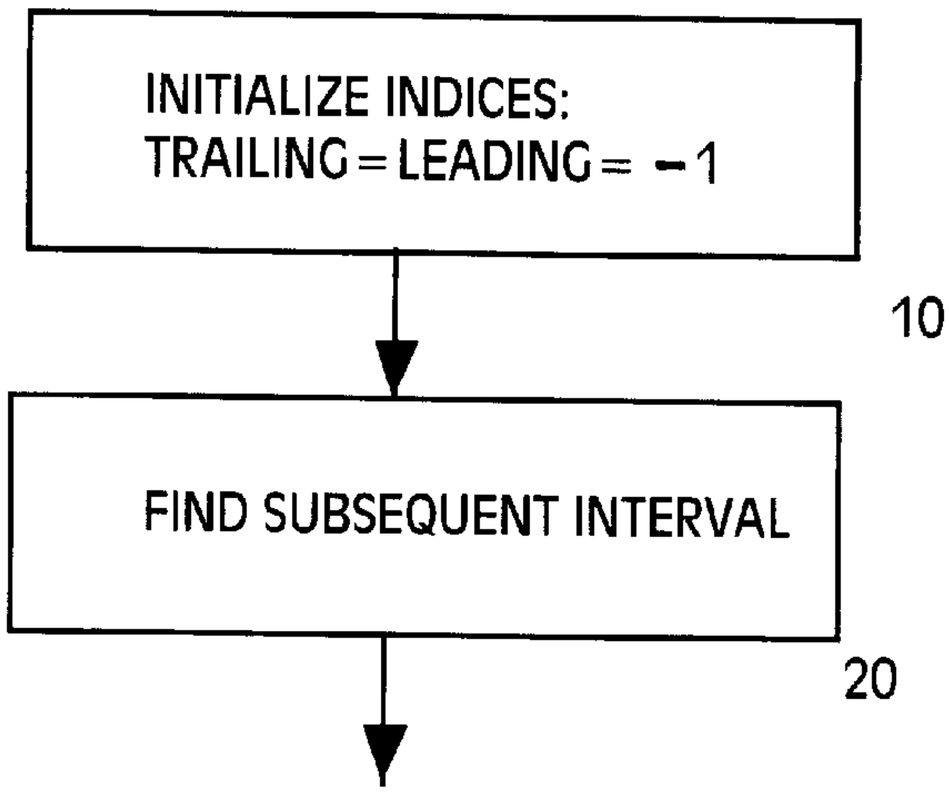

INITIALIZE INDICES:
TRAILING = LEADING = −1
10
FIND SUBSEQUENT INTERVAL
20

Fig. 23

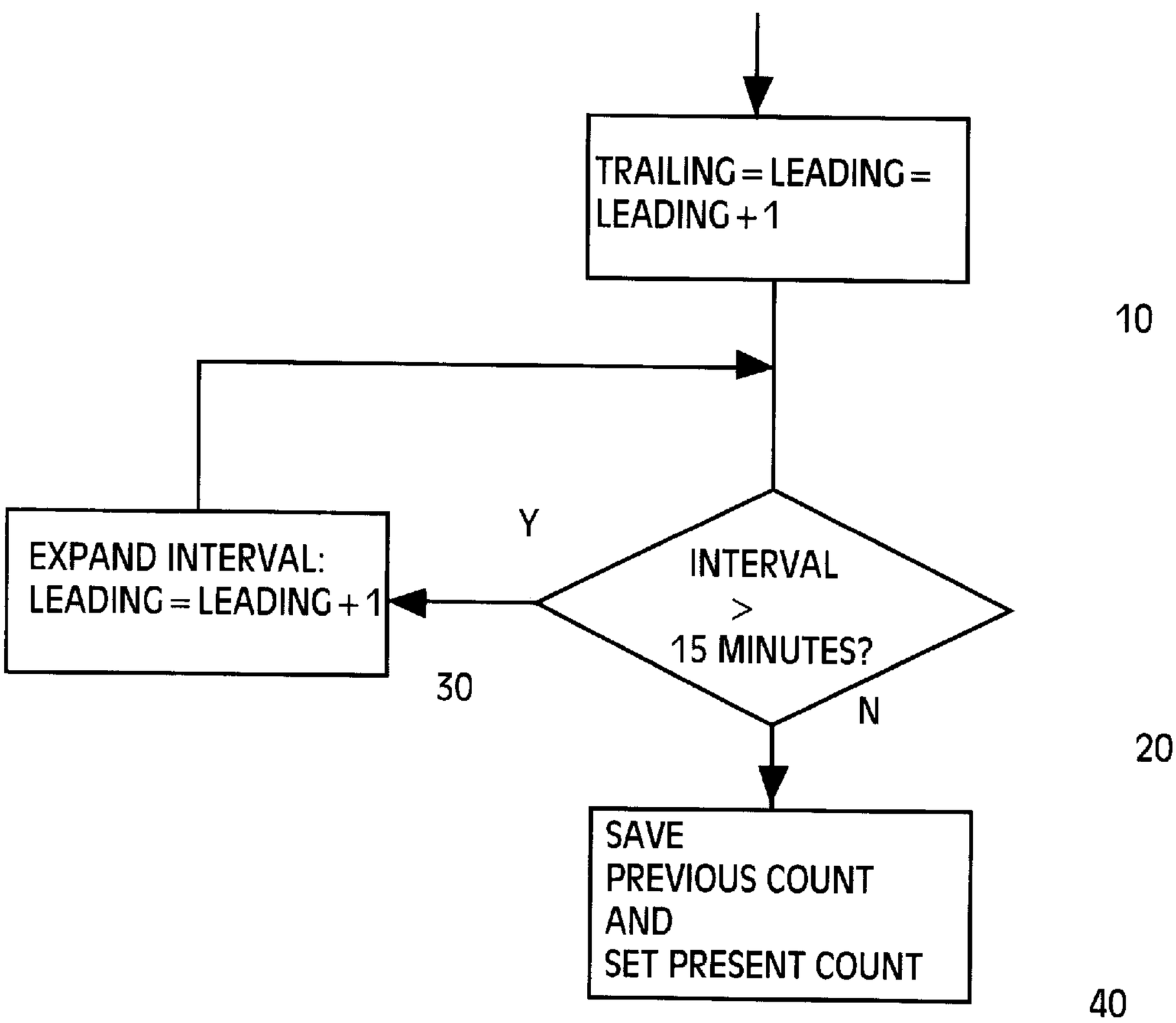

TRAILING = LEADING =
LEADING + 1
10
EXPAND INTERVAL:
LEADING = LEADING + 1
Y
INTERVAL
>
15 MINUTES?
30
N
20
SAVE
PREVIOUS COUNT
AND
SET PRESENT COUNT
40

Fig. 24

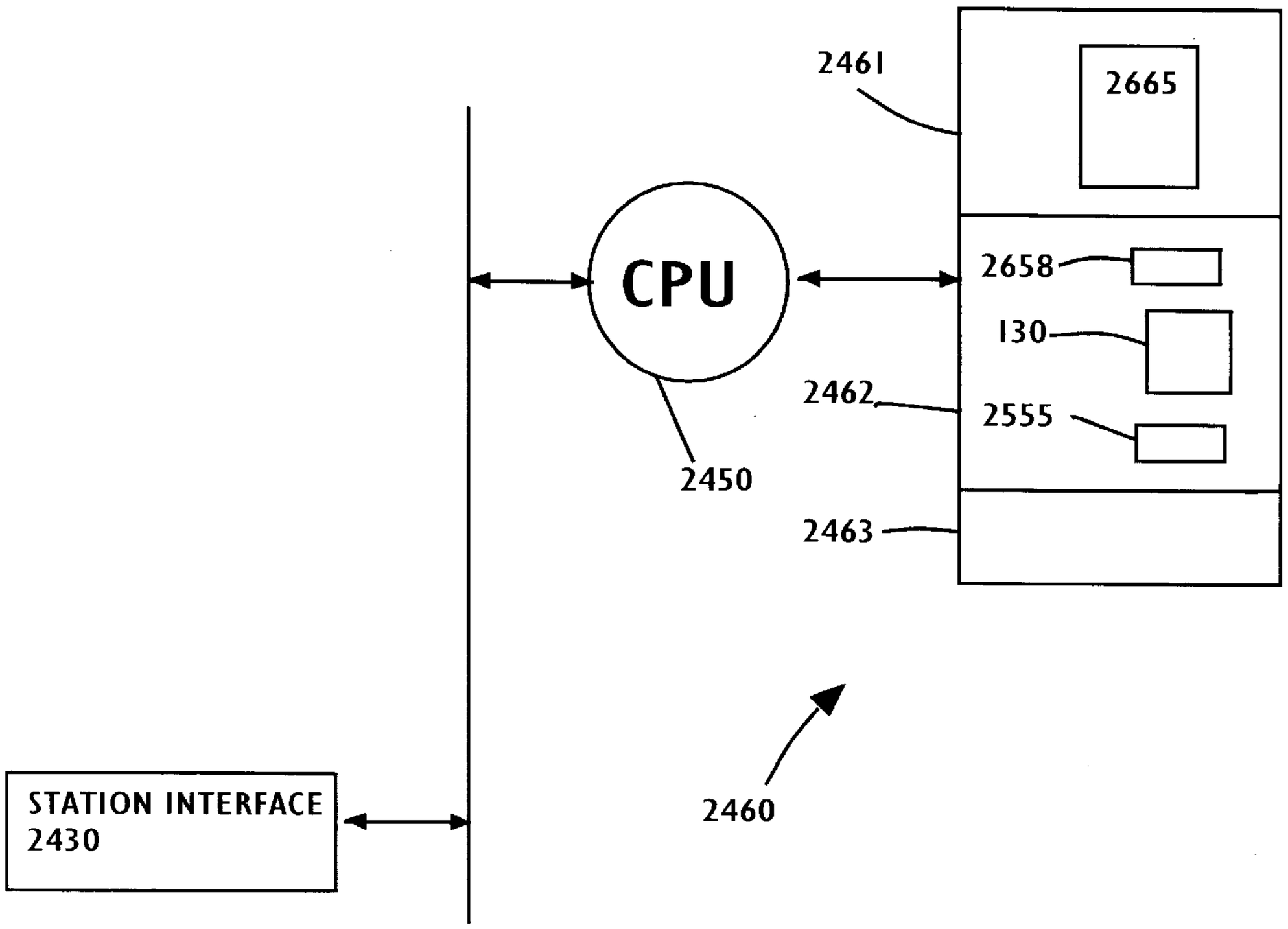

2461
2665
CPU
2658
130
2462
2555
2450
2463
2460
STATION INTERFACE
2430
65

Fig. 25

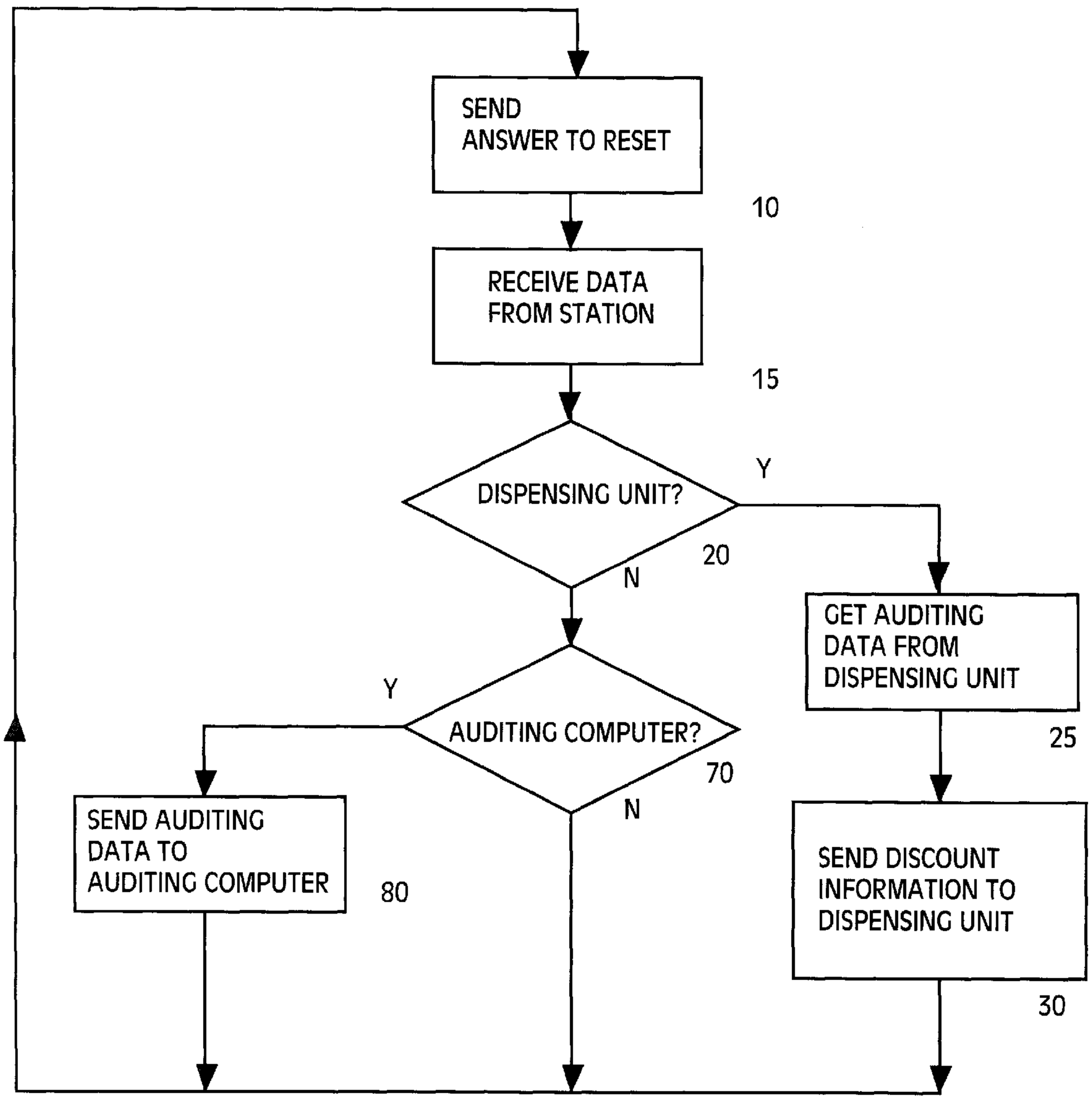

SEND
ANSWER TO RESET
10
RECEIVE DATA
FROM STATION
15
DISPENSING UNIT?
Y
20
N
GET AUDITING
DATA FROM
DISPENSING UNIT
25
SEND DISCOUNT
INFORMATION TO
DISPENSING UNIT
30
AUDITING COMPUTER?
Y
70
N
SEND AUDITING
DATA TO
AUDITING COMPUTER
80

Fig. 26

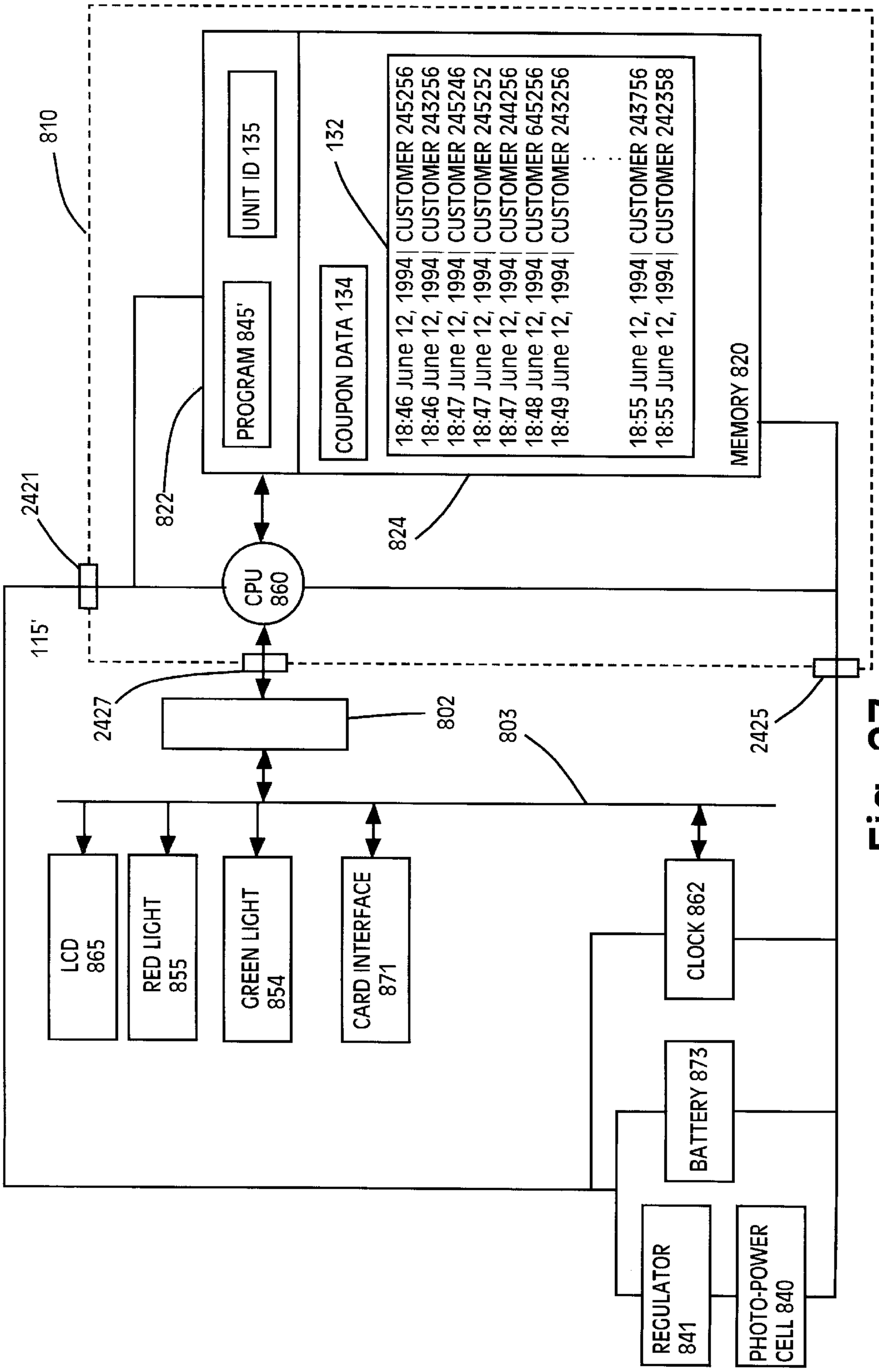

810
UNIT ID 135
132
18:46 June 12, 1994 CUSTOMER 245256
18:46 June 12, 1994 CUSTOMER 243256
18:47 June 12, 1994 CUSTOMER 245246
18:47 June 12, 1994 CUSTOMER 245252
18:47 June 12, 1994 CUSTOMER 244256
18:48 June 12, 1994 CUSTOMER 645256
18:49 June 12, 1994 CUSTOMER 243256
18:55 June 12, 1994 CUSTOMER 243756
18:55 June 12, 1994 CUSTOMER 242358
COUPON DATA 134
PROGRAM 845'
MEMORY 820
822
824
2421
CPU 860
115'
2427
802
803
2425
LCD 865
RED LIGHT 855
GREEN LIGHT 854
CARD INTERFACE 871
CLOCK 862
BATTERY 873
REGULATOR 841
PHOTO-POWER CELL 840

Fig. 27

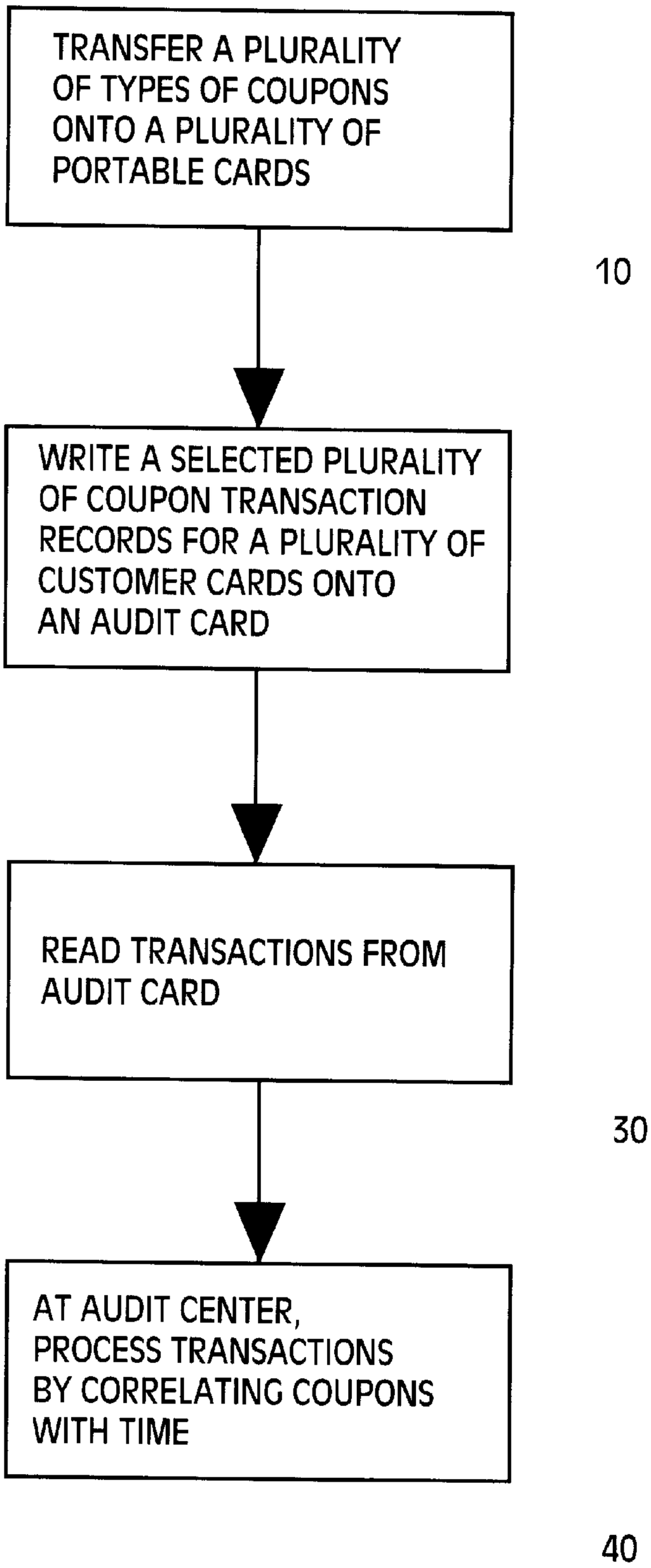

TRANSFER A PLURALITY OF TYPES OF COUPONS ONTO A PLURALITY OF PORTABLE CARDS
10
WRITE A SELECTED PLURALITY OF COUPON TRANSACTION RECORDS FOR A PLURALITY OF CUSTOMER CARDS ONTO AN AUDIT CARD
20
READ TRANSACTIONS FROM AUDIT CARD
30
AT AUDIT CENTER, PROCESS TRANSACTIONS BY CORRELATING COUPONS WITH TIME
40

FIG. 28

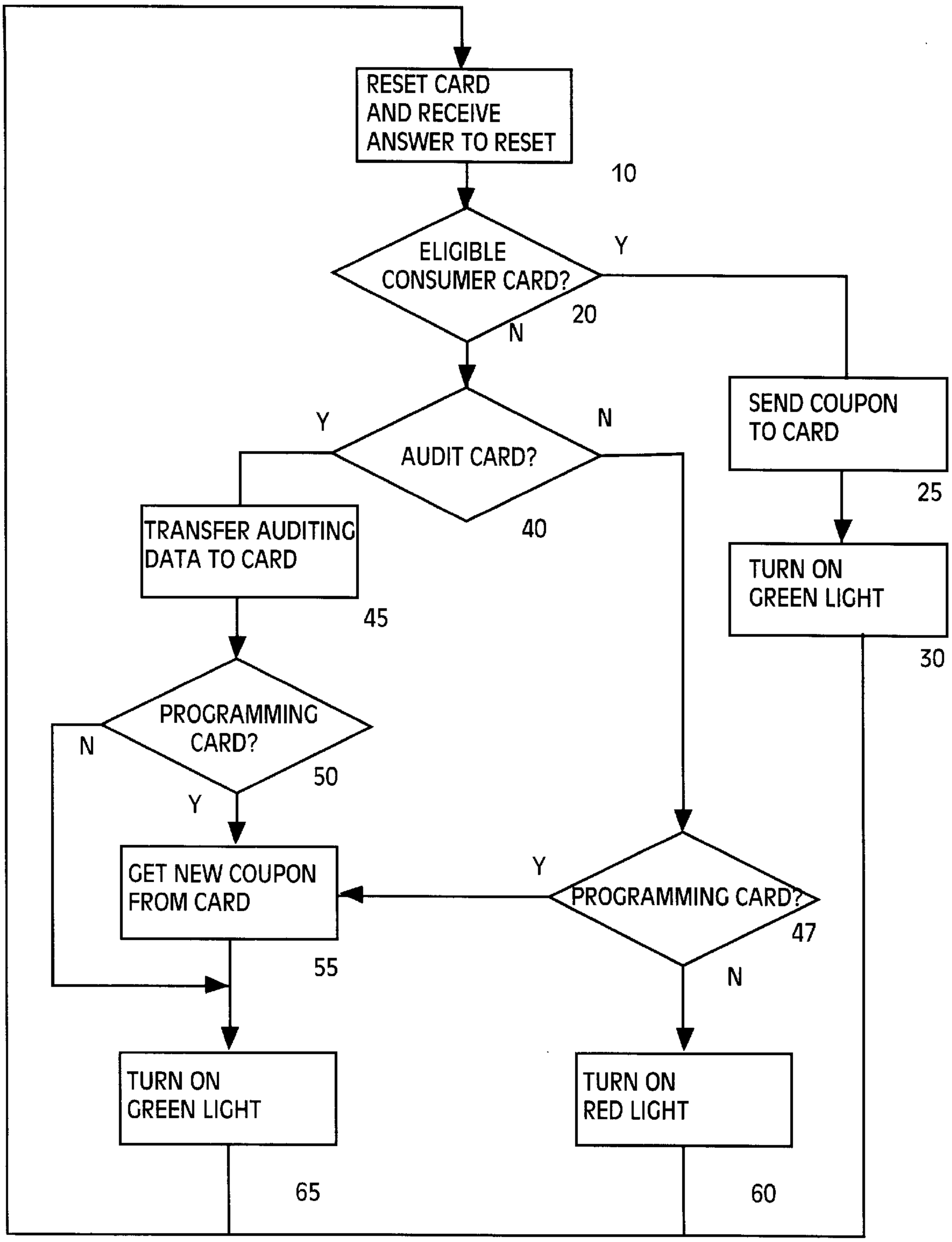

RESET CARD AND RECEIVE ANSWER TO RESET
10
ELIGIBLE CONSUMER CARD?
Y
20
N
SEND COUPON TO CARD
25
AUDIT CARD?
Y
N
40
TRANSFER AUDITING DATA TO CARD
45
TURN ON GREEN LIGHT
30
PROGRAMMING CARD?
N
50
Y
GET NEW COUPON FROM CARD
55
PROGRAMMING CARD?
Y
47
N
TURN ON GREEN LIGHT
TURN ON RED LIGHT
65
60

Fig. 29

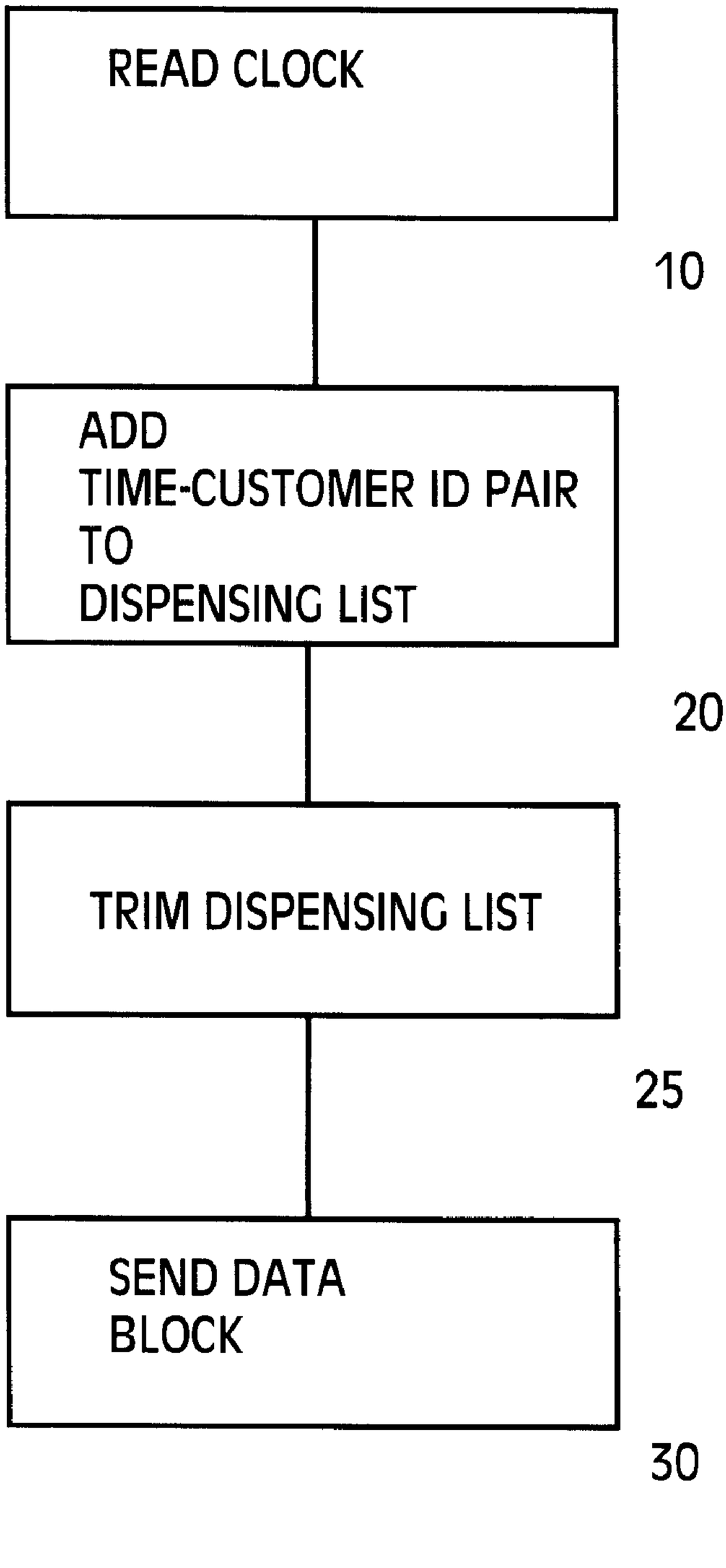

READ CLOCK
10
ADD
TIME-CUSTOMER ID PAIR
TO
DISPENSING LIST
20
TRIM DISPENSING LIST
25
SEND DATA
BLOCK
30

Fig. 30

SYSTEM AND METHOD FOR TRANSFERRING IDENTIFICATION INFORMATION BETWEEN PORTABLE CARDS IN A COMPUTERIZED RETAIL STORE HAVING COMMUNICATION AMONG A PLURALITY OF COMPUTERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to a system and method for auditing a retail system and, more particularly, to a system and method for auditing a system that provides credits for selected products.

2. Description of Related Art

Discount coupons are a popular means to stimulate sales of products such as grocery store items. In 1992, approximately 310 billion coupons were distributed and 7.7 billion coupons were redeemed, saving customers $4 billion. It has been estimated that in-store couponing coupled with advertising increases sales by 544%. Typical coupon marketing schemes, however, are susceptible to fraud by unscrupulous retailers that misredeems coupons, requesting reimbursement payments by presenting coupons to the clearing house, even though no corresponding products are purchased.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a system and method for detecting coupon dispensing patterns that may indicate coupon misredemption.

To achieve these and other objects of the present invention, there is a method for a system including a plurality of first cards each having a first memory and respective first signal, a second card, a first computer that receives from the second card, and a store including a plurality of products, a central computer, and a checkout station having an electromagnetic detector and a checkout computer. The method comprises sending a second signal to the first memory of a card in the plurality of first cards, the second signal corresponding to one of the plurality of products. The method further comprises the following steps, performed in the store, of communicating product data between the central computer and the checkout computer; receiving the first signal from the card in the plurality of first cards; sending the first signal to the second card; receiving, in the checkout computer, second signals from the card in the plurality of first cards; receiving a third signal from the electromagnetic detector, the third signal corresponding to a product in the store; and determining a price depending on whether the third signal corresponds to one of the received second signals.

According to another aspect of the present invention, there is a store for a system including a plurality of first cards each having a first memory and respective first signal, a second card, and a first computer that receives from the second card. The store comprises a plurality of products; a central computer; a checkout station including an electromagnetic detector for generating a third signal corresponding to a product, a checkout computer that communicates product data between the checkout computer and the central computer, and receives second signals from a card in the plurality of first cards. The store further comprises a determiner that determines a price depending on whether the third signal corresponds to one of the received second signals; a receiver that receives a first signal from the card in the plurality of first cards; and a sender that sends the first signal to the second card.

According to yet another aspect of the present invention, there is a card processing system in a system including a plurality of first cards each having a first memory and respective first signal, a second card, a first computer that receives from the second card, and a store including a plurality of products, a central computer, and a checkout station having an electromagnetic detector and a checkout computer that communicates product data between the central computer and the checkout computer. The card processing system comprises means for receiving the first signal from a card in the plurality of first cards; means for sending the first signal to the second card; means for receiving second signals from the card in the plurality of first cards; means for receiving a third signal from the electromagnetic detector, the third signal corresponding to a product in the store; and means for determining a price depending on whether the third signal corresponds to one of the received second signals.

According to yet another aspect of the present invention, there is a store for a system including a plurality of first cards each having a first memory and respective first signal, a second card, and a first computer that receives from the second card. The store comprises a plurality of products; a central computer; a checkout station including means for generating a third signal corresponding to a product, means for communicating product data with the central computer, and means for receiving second signals from a card in the plurality of first cards; means for determining a price depending on whether the third signal corresponds to one of the received second signals; means for receiving a first signal from the card in the plurality of first cards; and means for sending the first signal to the second card.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a retail system in accordance with the first preferred embodiment of the invention.

FIG. **2** is a block diagram emphasizing a portion of the system shown in FIG. **1**.

FIGS. **3**A and **3**B are a schematic diagram emphasizing another portion of the system shown in FIG. **1**.

FIGS. **4**A, **4**B, and **4**C are enlarged views of some of the products shown in FIGS. **3**A and **3**B.

FIG. **5**A is a plan view of the audit card in the first preferred system.

FIG. **5**B is a side view of the card shown in FIG. **5**A.

FIG. **5**C is an enlarged, partial view of the card shown in FIG. **5**A.

FIG. **6** is a block diagram of the audit card.

FIG. **7** is a block diagram of one of the customer cards.

FIGS. **8**A and **8**B are exterior views of one of the dispensing units for transferring an electronic coupon to the card.

FIG. **9** is a block diagram of the dispensing unit shown in FIGS. **8**A and **8**B.

FIG. **10** is a block diagram of the check-out station shown in FIG. **1**.

FIG. **11** is a flow chart of a processing performed by the first preferred embodiment of the invention.

FIG. **12** is a flow chart showing a step of the processing of FIG. **11** in more detail.

FIG. **13** is another flow chart showing a step of the processing of FIG. **12** in more detail.

FIGS. **14**A and **14**B are diagrams of some memory contents of the customer card at different points in time.

FIG. **15** is another flow chart showing a step of the processing of FIG. **12** in more detail.

FIG. **16** is another flow chart showing a step of the processing of FIG. **12** in more detail.

FIGS. **17**A and **17**B are diagrams of some memory contents of one of the dispensing units at different points in time.

FIG. **18** is a flow chart of a processing performed by the check-out station.

FIG. **19** is a flow chart of a processing performed by one of the customer cards.

FIG. **20** is a flow chart of a processing performed by the auditing card.

FIG. **21** is a flow chart of a processing performed by the auditing center.

FIG. **22** is a print out from one of the steps shown in FIG. **21**.

FIG. **23** is flow chart showing a processing of a step of FIG. **21** in more detail.

FIG. **24** is another flow chart showing a processing of another step of FIG. **21** in more detail.

FIG. **25** is a block diagram of an alternative audit card that includes a dispensing unit programming feature.

FIG. **26** is a flow chart of a processing performed by the alternative auditing card shown in FIG. **25**.

FIG. **27** is a block diagram of a dispensing unit of a second preferred embodiment of the invention.

FIG. **28** is a flow chart of a processing performed by the second preferred embodiment of the present invention.

FIG. **29** is another flow chart showing an aspect of the processing of the dispensing unit shown in FIG. **27**.

FIG. **30** is another flow chart showing the processing of a step shown in FIG. **29** in more detail.

FIG. **31** shows an in-store central computer.

The accompanying drawings which are incorporated in and which constitute a part of this specification, illustrate embodiments of the invention and, together with the description, explain the principles of the invention, and additional advantages thereof. Throughout the drawings, corresponding parts are labeled with corresponding reference numbers.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Preferred Embodiment

FIG. **1** shows a retail system in accordance with a first preferred embodiment of the present invention. A coupon dispensing unit within each of store **105**, **205**, and **305** dispenses coupons to customers in the store. Customers redeem these coupons at a check out station within the store.

Each of stores **105**, **205**, and **305** sends a respective signal to auditing center **500** via a signal path. The signal path between store **105** and center **500** includes a portable audit card **120**. Card **120** is approximately the size of a credit card. Card **120** contains a random access memory for storing an audit card signal. This audit card signal includes the unit ID of a discount coupon dispensing unit from which card **120** collected dispensing data. This audit card signal also includes a UPC coupon ID, which is a 12 digit number identifying the coupon in the format documented by the Uniform Code Council, Inc. of Dayton, Ohio. The audit card signal also includes a list of dispensing transactions, each record in the list including a customer ID and the time that the coupon was dispensed to the customer. The time includes the date and the time of day.

Similarly, audit card **220** sends an audit card signal to auditing center **500**, reflecting coupons dispensed by a coupon dispensing unit within store **205**.

Store **305** sends coupon dispensing data to auditing center **500** via telephone signal path **320**, instead of an audit card.

FIG. **2** shows a block diagram of auditing center **500**. CPU **550** executes system program **551** in random access memory (RAM) **520**. Various parts of the data in RAM **520** may be transferred between RAM **520** and disk memory **525** using a virtual memory mapping scheme, as is well known in the art.

Administrator **510** receives audit card **120** through the mail and inserts audit card **120** into card reader **570**. CPU **550** and program **551** act to read the audit card signal from card **120**, via reader **570**. CPU **550** then transfers the audit card signal **130** from card **120** to RAM **520**, as shown is FIG. **2**. Audit card signal **130** includes coupon data **134**, a dispensing unit ID **135**, and a list of dispensing transactions **132**.

Subsequently, CPU **550** processes the dispensing transactions to detect instances where a relatively large number of coupons are dispensed in a short period of time. Upon detecting such a series of dispensing transactions, CPU **550** sends a signal to printer **519** to print a report on paper **517**. To identify the store in which these transactions occurred, CPU **550** prints a store identification on paper **517** by translating the dispensing unit ID **135** into a store ID, using unit ID-store ID map **523**.

Periodically, audit center **500** receives dispensing data from store **305**, via modem **512** and telephone signal path **320**. Similar to the audit card signal **130** received via the portable audit cards, the dispensing data received via modem **512** includes the identification of a dispensing unit within store **305**, coupon data, and a list of dispensing transactions.

FIGS. **3**A and **3**B show store **105**. FIGS. **3**A and FIG. **3**B are each a partial view of store **105**. Customers **210**, **220**, **230**, **240**, **250**, **270**, **280**, and **290**, shop in store **105**. Before shopping in the store, each of these customers obtained a portable customer card. For example, customer **230** may have obtained customer card **235** from store **105** or from a bank, by completing an application. The application contained questions to collect demographic data, including birth date, income level, past buying patterns, geographic location, size of family, level of education, and job-related data. The card-issuer subsequently wrote customer identification data for customer **230** onto customer card **235**, and issued customer card **235** to customer **230**, and sent the customer's demographic data to a clearinghouse which then stored the demographic data on disk. Each of customers **210**, **220**, **240**, **250**, **270**, **280**, and **290** obtains a respective customer card in a similar manner.

To create an electronic coupon, a customer inserts her card into a coupon dispensing unit, such as unit **115**, adjacent to a product, such as bottles of ammonia **112**. The dispensing unit then writes an electronic coupon onto the card. The customer then removes the product from the shelf and places the removed product into her cart. The customer thus shops throughout the store collecting electronic coupons and products. Upon completion of shopping, the customer brings the removed products to checkout counter **700**. The customer redeems the electronic coupons at the checkout area, by inserting her customer card into checkout station **715**.

In FIG. **3**B, service worker **50** carries auditing card **120** for collecting dispensing data from a dispensing unit. Worker **50** inserts card **120** into one of the dispensing units to collect dispensing data from the dispensing unit. Subsequently, store personnel mail card **120** to auditing center **500**.

Detailed Hardware Description

Store **105** includes shelves **10**, **20**, and **30**, defining aisles between the shelves. Store **105** has a plurality of product areas, each corresponding to a respective product. Product Area **110** has Acme brand ammonia. Product Area **126** has Delta brand dish detergent. Product Area **136** has Lighthouse brand light bulbs.

Some of the product areas have a respective dispensing unit for depositing coupons onto a customer card, described in more detail below. Product Area **110** has dispensing unit **115**, product Area **126** has dispensing unit **125**, product Area **136** has dispensing unit **135**, product Area **140** has dispensing unit **145**, product Area **160** has dispensing unit **165**, product Area **170** has dispensing unit **175**, product Area **180** has dispensing unit **185**, and product Area **190** has dispensing unit **195**.

Product area **110** has bottles of ammonia **112** contiguously grouped together on multiple shelves. Bottles of ammonia **112** are contiguously grouped, meaning that no other product is between any two bottles of ammonia **112**. FIG. **4**A shows an enlarged view of some of the bottles of ammonia **112**. Each bottle of ammonia has a common Universal Product Code (UPC) symbol **114**. Symbol **114** encodes a 12-digit number that is part of a product identification system documented by the Uniform Code Council, Inc., Dayton, Ohio. In UPC Product Code format, the first digit is a 0, designating a product. The next five digits are a manufacturer ID. The next 5 digits are an item number. The last digit is a check digit.

Each UPC symbol **114** is a group of parallel lines that encodes a number (0 17075 00003 3) that uniquely identifies acme ammonia. In other words, symbol **114** is different from UPC symbols of units of other products. Each bottle of ammonia **112** also has a common character label **113** that verbally describes the product. Character label **113** is "ACME AMMONIA." Label **113** is different from labels of units of other products.

Product Area **126** has boxes of pasta **122** contiguously grouped together on multiple shelves. FIG. **4**B shows an enlarged view of some of the boxes of pasta **122**. Each box of pasta **122** has a common UPC symbol **124**, which is a group of parallel lines that encodes a number (0 17031 00005 3) that uniquely identifies Old World pasta. In other words, symbol **124** is different from UPC symbols of units of other products. Each box of pasta **122** also has a common character label **123** that verbally describes the product. Character label **123** is "OLD WORLD PASTA." Label **123** is different from labels of units of other products.

Product Area **136** has boxes of light bulbs **132** grouped together on multiple shelves. FIG. **4**C shows an enlarged view of some of the boxes of light bulbs **132**. Each box of light bulbs **132** has a common UPC symbol **134**, which is a group of parallel lines that encode a number (0 17054 1017 6) that uniquely identifies Lighthouse light bulbs. In other words, symbol **134** is different from UPC symbols of other products. Each box **132** also has a common character label **133** that verbally describes the product. Character label **133** is "LIGHTHOUSE LIGHT BULBS." Label **133** is different from labels of other products.

Similarly, other product areas in store **105** each have a set of respective products contiguously grouped together. Respective units of a certain product have a common UPC symbol, different from UPC symbols on units of other products, that uniquely identifies the certain product. Respective units of a certain product have a common label, different from labels on units of other products, that uniquely identifies the certain product. Product area **140** has bottles of ketchup **142** contiguously grouped together. Product area **160** has loaves of bread **162** contiguously grouped together. Product area **170** has cartons of milk **172** contiguously grouped together. Product area **180** has packages of bacon **182**. Product area of **190** has packages of butter **192** contiguously grouped together. Product area **111** has boxes of paper towels contiguously grouped together. Product area **121** has rolls of paper towel contiguously grouped together. Product area **141** has boxes of crackers contiguously grouped together. Product area **151** has canned fruit contiguously grouped together. Product area **161** has canned vegetables contiguously grouped together. Product area **171** has cans of meat contiguously grouped together. Product area **181** has boxes of flour contiguously grouped together.

FIG. **5**A shows a plan view of audit card **120** carried by service worker **50**, and FIG. **5**B shows a side view of card **120**' Card **120** is 8.5 cm by 5.4 cm, the length and width of a typical financial credit card. Card **120** is slightly thicker than a typical financial credit card. Card **120** includes a magnetic stripe **2410**, interface contacts **2420** for communication with the dispensing units and the checkout station, and embossed area **2430** for displaying human-readable data. Magnetic stripe **2410** allows a conventional credit card stripe reader to read basic data from the card. Magnetic stripe **2410** is not necessary to the operation of the preferred embodiments of the invention, described in more detail below.

FIG. **5**C shows interface contacts **2420** in more detail. Interface contacts **2420** are configured in accordance with ISO7816-2: 1988(E), Identification cards—Integrated circuit(s) cards with contact—Part **2**: Dimensions and locations of the contacts, promulgated by the International Organization for Standardization (ISO), and available from the American National Standards Institute (ANSI), 11 West 42nd Street, New York, N.Y. 10036. According to ISO 7816-2, contact **2421** is assigned to VCC (supply voltage), contact **2422** is assigned to RST (reset signal), contact **2423** is assigned to CLK (clock signal), contact **2424** is reserved for future use, contact **2425** is assigned to GND (ground), contact **2426** is assigned to VPP (program and voltage), contact **2427** is assigned to I/O (data input/output), and contact **2428** is reserved for future use. Card **120** communicates with the dispensing units and the checkout stations through contact **2427** using a half duplex scheme, meaning that contact **2427** is for communicating data signals either to or from the card.

FIG. **6** is a block diagram of audit card **120**, including central processing unit **2450**, processor **2450**, and memory **2460**. Random access memory **2460**, includes three addressable segments: nonvolatile read only memory (ROM) **2461**; nonvolatile, electrically erasable memory (EEPROM) **2462**; and memory **2463** for temporary storage. Station interface **2425** includes a serial to parallel converter for transferring data signals between contact **2427** and CPU **2450** over parallel bus **2452**. ROM **2461** stores a program **2465** executed by processor **2450**. EEPROM **2462** stores authorization data **2468**. Authorization data **2468** contains a field identifying that the card is an audit card (rather than a customer card). EEPROM **2462** also stores an audit card

signal **130**, encoding data received from one of the dispensing units (see FIG. **2**).

FIG. **7** is a block diagram of customer card **215** in which elements corresponding to audit card **120** are labeled with corresponding reference numbers. Customer card **215** has the same exterior structure as that of the audit card **120** described above in connection with FIGS. **5**A–**5**C. Customer card **215** also has the same hardware structure as programming card **120**. Random access memory **2460**, includes three addressable segments: nonvolatile read only memory (ROM) **2461**; nonvolatile, electrically erasable memory (EEPROM) **2462**; and memory **8463** for temporary storage. The contents of memory **2460** of customer **215**, however, are different from that of memory **2460** of audit card **120**. ROM **2461** of card **215** stores a program **7465** executed by processor **2450**. EEPROM **2462** stores customer identification data **2467**, and authorization data **2465**. Customer identification data **2467** includes a sequence of digits that uniquely identifies the holder of the card. Customer identification data **2467** includes the card holder's social security number, thereby uniquely identifying customer **210**. Authorization data **2465** includes a sequence of digits that includes a code identifying the store or stores in which the card may be used to obtain a paperless coupon. Authorization data **2465** also includes an expiration date for the card. Depending on the card holder's contractual relationship with the card issuer, the card issuer may periodically update this date data to renew the card when the current date data indicates the card is expired. Store authorization data **2465** also contains a field identifying that the card is a customer card (rather than an audit card, which is described below).

EEPROM **2462** of card **215** also stores a list **2435** of coupons received from one or more of the dispensing units. When a customer inserts a customer card into one of the dispensing units, processor **2450** receives an electronic coupon for the product from the station and adds the code to list **2435**.

Each of customer cards **225**, **235**, **245**, **355**, **275**, and **295** has the same hardware structure as customer card **215**.

FIG. **8**A shows a front view of dispensing unit **115**, and FIG. **8**B shows a side view of dispensing unit **115** taken along the line B—B in FIG. **8**A. Dispensing unit **115** includes green light **855**, red light **854**, and interface slot **870**. Unit **115** also includes liquid crystal display (LCD) **865** for displaying product promotional messages, and a photo-power cell **840** (sometimes called a solar cell) for converting ambient light to electricity for powering dispensing unit **115**. Ambient light includes light **107** emitted from ceiling lights **106** mounted in the ceiling of store **105**.

Interface slot **870** has a width sufficient to accommodate one of the customer cards or an audit card. When a card is in interface slot **870**, conductive contact **877** inside interface slot **870** touches contact **2427** on the card. Interface slot **870** has other contacts (not shown) for touching the other card contacts **2420**.

Dispensing unit **115** has no external wires connecting station **115** to another device.

As shown in FIG. **8**B, dispensing unit **115** includes a processor and memory inside of control card **810**. Control card **810** has an exterior identical to that of the audit card shown in FIGS. **5**A–**5**C.

FIG. **9** shows a block diagram of dispensing unit **115**, including control card **810** having central processing unit **860** and random access memory **820**. Memory **820** includes a read only memory (ROM) area **822** for storing a program **845**, executed by CPU **860**, a respective unit ID **135** that uniquely identifies dispensing unit **115** in the first preferred retail system. Each dispensing unit in the first preferred system has a respective unit ID **135**.

Memory **820** also include a read/write memory area **824** for storing coupon data **134** and dispensing transaction list **132**.

Control card **810** is electrically coupled to other parts of dispenser **115** via contacts **2420** on control card **810**. Card interface circuitry **802** includes a serial to parallel converter allowing CPU **860** to control parallel bus **803** the serial I/O contact **2427**.

Dispensing unit **115** also includes clock **862**, battery **873**, card interface circuitry **871**, and photo-power cell **840**. Card interface circuitry has a connection (not shown) to battery **873**. Card interface circuitry **871** powers a card in interface slot **870**, and otherwise sends and receives signals from the contacts in interface slot **870**. Photo-power cell **840** is coupled in parallel to battery **873** via voltage regulator **841**, to charge battery **873** when sufficient light is received by photo-power cell **840**.

Each dispensing unit has the same hardware structure as dispensing unit **115**. Each dispensing unit is locked to one of the shelves with a keyed lock.

FIG. **10** is a block diagram of checkout counter **700** shown in FIG. **3**B. Disk **725** provides long term storage. CPU **750** executes instructions in random access, addressable memory **720**. Transformer **705** transforms 60Hz line power into DC power and provides the DC power to CPU **750** memory **720**, UPC reader **710**, checkout station **715**, and other electronics within checkout counter **700**. UPC reader **710** detects an optical (electromagnetic) signal reflected from a UPC product symbol.

CPU **750** and program **722** act to detect a product scanned by UPC reader **710**, determine a reference price for the product, search for the product's identification in the memory of a customer card, and deduct a discount from the reference price if the product is identified in the customer card memory. CPU **750** then displays the price of the product on display **717**. CPU **750** writes coupon redemption data onto disk **725**.

Detailed Processing Description of First Preferred Embodiment

FIG. **11** shows a processing performed by the first preferred system. Dispensing unit **115** transfers a plurality of coupons onto a plurality of customer cards and records these coupon transfers in list **132** in memory **820** of FIG. **9**. (step **10**). After dispensing a plurality of coupons over a period of time, dispensing unit **115** sends list **132** to audit card **120**, in response to the insertion of card **120** into unit **115**. (step **20**). Subsequently, the personnel of store **105** mail audit card **120** to auditing center **500**. After auditing center **500** receives card **120**, CPU **550** reads audit card signal **130** from card **120** via card reader **570** and stores signal **130** into RAM **520** of FIG. **2**. (step **30**). Subsequently, CPU **550** determines the number of coupons transferred per unit time, to detect suspicious coupons dispensing patterns. (step **40**).

FIG. **12** shows a processing performed by processor **860** and program **845** in dispensing unit **115** to effect steps **10** and **20** of FIG. **11**. When a customer card is in interface slot **870**, conductive contacts (not shown) inside interface slot **870** touch each card contact **2420**, thereby applying power from the interface to the card. A switch (not shown) in interface slot **870** alerts processor **860** that a card has been inserted into the slot. Subsequently, processor **860** causes

card interface circuitry **871** to reset the card by applying a clock signal to contact **2423** of the card in interface slot **870**, via the contacts in interface slot **870**. (If the card is a customer card, the card then answers the reset by sending a block of data, including identification data **2467** and authorization data **2465**, through card contact **2427**. Authorization data **2465** contains a card-type code indicating a customer card. If the card is an audit card, the card send then answers the reset by sending a data block, including authorization data **2468**, through card contact **2427**. Authorization data **2468** has a card-type code indicating an audit card.) Processor **860** then receives then receives the answer-to-reset data block from the card. (step **10**).

The communication protocol between dispensing unit **115** and a customer card or an audit card is described in more detail in ISO/IEC 7816-3: 1989 (E), identification cards—Integrated circuit(s) cards with contacts—Part **3**: Electronic signals and transmission protocols; and ISO/IEC 7816-3: 1989/Amd.1: 1992 (E), Part **3**: Electronic signals and transmission protocols, AMENDMENT 1: Protocol type T=1, asynchronous half duplex block transmission protocol. Both of these standards are promulgated by the International Organization for Standardization (ISO) and distributed by the American National Standards Institute (ANSI).

Processor **860** analyzes the authorization data in the received answer-to-reset block to determine whether the card is a customer card that is eligible to receive paperless coupons in store **105** (step **20**). Processor **860** determines that the card is a customer card if the received authorization data contains a card-type code indicating a customer card. If the card is a customer card, meaning that the authorization data is authorization data **2465**, processor **860** determines if the card is eligible to receive paperless coupons in store **105** if authorization data **2465** contains a store code indicating store **105**, and the current time and date (as indicated by a date-time clock **862**) is not later than the date data in authorization data **2465**. If the card is an eligible customer card, processor **860** sends a discount coupon for bottles of ammonia **112**. (step **25**). Processor **860** then turns on green light **854** to indicate to the customer that an electronic coupon has successfully been transferred to her customer card (step **30**), thereby allowing the customer to verify whether she received a discount coupon before selecting the product.

Processor **860** determines that the card is an audit card if the received authorization data contains a card-type code indicating an audit card. If the card is an auditing card, meaning that the received authorization contains a card-type code indicating an audit card (step **40**), processor **860** sends unit ID **135**, coupon data **134**, and transaction list **132** to the card. (step **45**).

Another type of card is a programming card that changes the coupon dispensed by a dispensing unit. A portable card may be both an auditing card and a programming card. Thus, step **50** determines whether the audit card is also a programming card. If the card is a programming card as well as an auditing card, meaning that the received authorization contains a card-type code indicating both auditing card and a programming card (step **50**), processor **860** gets a new coupon from the card and writes the new coupon into the location for coupon data **134** in memory **820**. (step **55**). Processor **860** then turns on green light **854** to indicate to the service worker that an auditing and/or programming operation has been successfully performed. (step **65**).

If the card is not an auditing card (step **40**) and is a programming card (step **47**), processor **860** also performs the processing of steps **55** and **65**.

If the card is neither an eligible consumer card (step **20**), an auditing card (step **40**), nor a programming card (step **47**), processor **860** turns on the red light to indicate that no transaction was successfully performed with the inserted card. (step **60**).

In summary, dispensing unit **115** (one of a plurality of card interfaces) includes electrical contact **877**. Dispensing unit **115** reads identification data **2467** (a first signal) from customer card **215**. Dispensing unit **115** reads this first signal through contact **877**. Dispensing unit **115** sends a coupon signal (a second signal) through contact **877** to the customer card. Subsequently, dispensing unit **115** sends a third signal, associating the first and second signals, to an audit card **120**. Dispensing unit **115** sends this third signal through contact **877**.

FIG. **13** shows the processing of step **25** of FIG. **12**, sending a coupon to a customer card, in more detail. Processor **860** reads the date-time clock **862** (step **10**) and adds an record to dispensing list **132**. (step **20**). The record includes the read date-time and the customer identification data **2467**. Thus, processor **860** reads identification data **2467** (a first signal) from customer card **215**, in response to a person presenting card **215** to dispensing unit **115**.

Processor **860** then sends to the customer card a data block containing a type code indicating a dispensing unit, and coupon data **134**. (step **30**). Thus, processor **860** writes coupon data **134** (a second signal) into EEPROM **2462** of card **215**, in response to the person presenting card **215** to dispensing unit **115**, coupon data **134** corresponding to bottles of ammonia **112** (one of the plurality of products in the first preferred retail system). Dispensing list **132** is essentially a third signal, each record in list **132** associating the first signal with the second signal.

FIG. **14A** shows some the contents list **2435**, starting at offset **30**, in EEPROM **2462** of customer card **215**, before processor **860** of the dispensing unit executes step **30** of FIG. **13**. Each row of list **2435** shows an electronic coupon in the 12 digit number in UPC Coupon Code format. In this format, the first digit is a 5, designating a coupon. The next five digits are a manufacture ID. The next 3 digits are a family code. The next 2 digits are a value code. The last digit is a check digit. In FIG. **14**A, customer card **215** is storing two electronic coupons in list **2435**, reflecting the fact that customer **210** has received electronic coupons from coupon dispensing units. After processor **860** executes step **30** of FIG. **13** (thereby sending another electronic coupon to the customer card), CPU **2450** in customer card **215** receives the data and adds the data to list **2435**, resulting in three electronic coupons in list **2435** as shown in FIG. **14**B.

FIG. **15** shows the processing of step **45** of FIG. **12**, transferring auditing data to an auditing card, in more detail. Processor **860** constructs a data block including the unit ID **135**, coupon data **134**, and dispensing list **132** from memory **820**. Processor **860** then sends this data block to the auditing card. (step **10**). Processor **860** then clears list **132** by setting a variable LIST_RECORD_COUNT=0 (step **20**).

FIG. **16** shows the processing of step **55** of FIG. **12** in more detail. Processor **860** receives new data from the card (step **10**) and changes coupon data **134** by writing the new data to the location of data **134** in memory **820** (step **20**), thereby changing the electronic coupon dispensed by the dispensing unit.

FIG. **17**A shows product data coupon data **134** in memory **820** before the execution of step **30** of FIG. **16**, and FIG. **17**B shows coupon data **134** after step **30**. In this example **5 17075 278 30 7** is a coupon for purchase of a bottle of

ammonia bottle **112**. FIG. **17**B shows a coupon for a different product.

FIG. **18** shows a processing performed by CPU **750** and program **722** in checkout counter **700**, when a customer checks out of store **105**. Wvhen a customer, such as customer **290**, inserts customer card **295** into interface slot **714**, a switch (not shown) in interface slot **714** alerts CPU **750** that a card has been inserted into the slot. When a customer card is in interface slot **714**, conductive contacts (not shown) inside interface slot **714** touch each card contact **2420**, thereby applying power from the interface to the card. Subsequently, CPU **750** causes card interface **725** to reset the card by applying a clock signal to card contact **2423**. (If the card is a customer card, the card then answers the reset by sending a block of data, including identification data **2467** and authorization data **2468**, through card contact **2427**.) CPU **750** then receives the answer-to-reset from the card (step **2**). CPU **750** then sends a data block containing a station-type code indicating a checkout station (step **4**). CPU **750** then receives the contents of table **2435** in EEPROM **2462** of the customer card, and temporarily stores these table contents in memory **720** of the checkout station (step **5**). During step **5**, CPU **750** alsp causes customer card **295** to remove all entries from list **2435**, so that the electronic coupons in the list cannot be redeemed again. During step **5**, CPU **750** also translates the value code of each received UPC coupon code into a discount quantity corresponding to the code. CPU **950** then makes a record including the coupon and the discount amount, and adds this record to a temporary coupon list **744** in memory **720** To perform this translation, CPU **750** may communicate with an in-store central computer that contains tables for translating the value field of UPC coupon codes into a discount quantity.

When the checkout clerk (not shown) moves a product past UPC reader **710**, UPC reader **710** detects the UPC code on the product and sends the UPC code to CPU **750** (step **10**). CPU **750** determines whether the product scanned has a corresponding coupon in list **744** (step **20**). If the product has a corresponding coupon in list **744**, CPU **750** deletes the coupon from list **744**. In other words, CPU **750** searches list **744** for a corresponding coupon. A product corresponds to a coupon if the five-digit manufacturer ID in the UPC coupon code equals the five-digit manufacturer ID in the UPC coupon code, and the three-digit coupon family code for the product corresponds to the three-digit family code of the coupon. These two family codes correspond if they are equal or if the coupon family code is a summary code that matches certain digits of the product's coupon family code, as described more fully in the UPC Coupon Code Guidelines Manual, reprinted October 1994, from the Uniform Code Council, Inc., Dayton, Ohio.

If the product has a coupon, CPU **750** subtracts the discount, as determined by the discount quantity data stored in list **744**, from a product reference price read from disk **725** (step **30**), and displays the resulting price of the product on display **717** (step **40**).

In summary, card interface **725** (a second interface) receives second signals from the memory of one of the customer cards. CPU **750** receives a UPC product code (a fourth signal) from UPC reader **710**, and determines a price depending on whether the fourth signal corresponds to one of the received second signals.

CPU **750** may obtain the 3-digit family code for a product by sending the UPC coupon code to an in-store central computer **760** that contains tables **761** (FIG. **31**) for correlating UPC coupon codes with UPC product codes. An in-store central computer for sending product and coupon data to a cash register is described in applicant's copending U.S. Pat. application Ser. No. 08/299,688 of KEN R. POWELL for COMPUTER NETWORK FOR A RETAIL SYSTEM, filed Feb. 11, 1997, the contents of which is herein incorporated by reference.

FIG. **19** shows a processing performed by one of the customer cards, such as customer card **215**, in the first preferred retail system. After the card is reset through contacts **2420**, the customer card sends an "answer to reset" data block in accordance with the ISO standard ISO/IEC 7816-3: 1989(E), cited above. The customer card sends identification data **2467** and authorization data **2465** in the answer-to-reset data block (step **10**). If the station then sends a block of data to the customer card, the customer card then receives the block of data through contact **2427** (step **15**). If the block contains a station-type code indicating a dispensing unit (step **20**), the customer card then adds product coupon data, from a certain offset in the block, to the list **2345** (step **30**).

If the customer card is not eligible, the station will not send a block of data, step **15** therefore does not execute, and processing ceases until the customer card is reinserted into a station, at which time the station will reset the card and processing will restart at step **10**.

Alternatively, if the block contains a station-type code indicating a checkout station (step **70**), the customer card then sends list **2345** to the checkout station (step **80**). In other words, CPU **2450** reads list **2435** from EEPROM **2462**, in response to a customer inserting card **215** into checkout station **715**, and sends a signal corresponding to the list **2345** to the checkout station (step **80**).

In FIG. **3**B, service worker **50** carries auditing card **120** for auditing a dispensing unit. Service worker **50** creates a signal path to one of the dispensing units by inserting auditing card **120** into the interface slot of the dispensing unit. The auditing card then receives a signal, via contact **4177** identifying customers that received coupons from the dispensing unit. Service worker **50** then breaks the signal path by removing auditing card **120**.

FIG. **20** shows a processing performed by auditing card **120**. After the card is reset through contacts **2420**, the auditing card sends an "answer to reset" data block in accordance with the ISO standard ISO/IEC 7816-3: 1989 (E), cited above. The auditing card sends authorization data **2468** in the answer-to-reset data block (step **10**). The auditing card then receives the block of data through contact **2427** (step **15**). If the block contains a station-type code indicating a dispensing unit (step **20**), the auditing card then receives the signal including dispensing list **132**, identifying customers that received coupons (step **30**).

Alternatively, if the block contains a station-type code indicating an auditing computer (step **70**), the auditing card then sends the signal, received in step **30**, to the auditing computer (step **80**).

FIG. **21** shows a processing performed by CPU **550** executing program **551** in the auditing center shown in FIG. **2**. CPU **550** finds a section of list **132** encompassing a 15 minute interval of coupon dispensing. (step **10**). CPU **550** then finds the subsequent 15 minute interval of coupon dispensing. (step **20**). CPU **550** determines if the number of coupons dispensed in this subsequent interval exceeds the number of coupons dispensed in the previous interval by 50 coupons. (step **30**). If this difference in number of dispensed coupons exceeds **50**, CPU **550** generates a report for the

subsequent interval. (step **40**). CPU **550** then proceeds to step **20** to determine the next subsequent interval of 15 minutes.

FIG. **22** shows a print out on paper **517** of FIG. **2**, produced by the processing of step **40** of FIG. **21**. The printout of FIG. **22** alerts personnel in the auditing center that a particular dispenser in a particular store dispensed a relatively large number of coupons in a short period of time.

FIG. **23** shows the processing of step **10** of FIG. **21** in more detail. CPU **550** initializes indices for list **132** of FIG. **2**, by performing the variable assignment LEADING=TRAILING=−1. CPU **550** then gets the subsequent interval as determined by the present value of the variables TRAILING and LEADING. (step **20**).

FIG. **24** shows the processing of steps **20** in FIGS. **21** and **23** in more detail. To find the beginning of the subsequent interval, CPU **550** performs the variable assignments TRAILING=LEADING=LEADING+1. (step **10**). CPU **550** then determines if the difference between the beginning of the interval and the end of the interval is greater than 15 minutes. (step **20**); CPU **550** executes the following instruction:

```
DIFFERENCE (T_ARRAY [TRAILING, TIME], T_ARRAY
  [LEADING+1, TIME])>15
```

wherein T_ARRAY is an array of the records in list **132**, the first record being accessible using an index of 0. Each record includes a TIME field for storing the date and time at which a coupon was dispensed. Each record also includes a CUSTOMER_ID field for recording the customer to whom the coupon was dispensed. The fanction DIFFERENCE takes two arguments in the date-time format of the records in list **132**, and returns the difference in units of minutes.

If the difference is not greater than 15 minutes, CPU **550** expands the interval, by performing the variable assignment LEADING=LEADING+1. (step **30**). If the difference is greater than 15 minutes, CPU **550** saves the count of a previously processed interval by performing the variable assignment PREVIOUS_COUNT=PRESENT_COUNT; and sets the coupon count for the currently processed interval by performing the variable assignment PRESENT_COUNT=LEADING—TRAILING+1. (step **40**).

FIG. **25** shows a block diagram of an auditing/programming card **65** in accordance with an alternative embodiment of the present invention. Auditing/programming card **65** is similar to auditing card **120**, except that card **65** has program **2665** in ROM **2461**; and authorization data **2658**, and new discount data **2555** in EEPROM **2462**. Authorization data **2658** included a cardtype code indicating that the card is both an auditing card and a programming card.

FIG. **26** shows a processing performed by CPU **2450** and program **2665** in auditing/programming card **65**. After auditing/programming card **65** is reset through contacts **2420**, auditing/programming card **65** sends authorization data **2468** and authorization data **2658** in an answer-to-reset data block in accordance with the ISO standard ISO/IEC 7816-3: 1989(E), cited above (step **10**). Auditing/programming card **65** then receives a block of data through contact **2427** (step **15**). If the block contains a station-type code indicating a dispensing unit (step **20**), the auditing/programming card **65** card then receives the signal including dispensing list **132** (step **25**, and sends discount data **2555** (step **30**).

In summary auditing/programming card **65** sends a signal to dispensing unit **115** to change the product corresponding to the second signal.

Each dispensing unit in the first preferred system identical hardware to that of dispensing unit **115**. Each dispensing unit executes a program to perform the identical processing as that of dispensing unit **115**.

In store **305**, instead of mailing loaded auditing cards to center **500**, store personnel insert the loaded auditing card into a card reader within store **305**. A processor within store **305** then reads the audit card signal and send a corresponding signal to auditing center **500** via telephone signal path **320**.

Second Preferred Embodiment

FIG. **27** shows a block diagram of dispensing unit **115'** according to a second preferred embodiment of the present invention. Dispensing unit **115'** includes memory **820** having a read only memory (ROM) area **822** for storing a program **845'**, executed by CPU **860**. Each dispensing unit of the second preferred embodiment is similar to dispensing unit **115'**. Other features of the second preferred embodiment are similar to those of the first preferred embodiment.

FIG. **28** shows a processing performed by the second preferred embodiment. The processing of FIG. **28** is similar to that of FIG. **11**, described above in connection with the first preferred embodiment, except that step **20** of FIG. **28** does not necessarily write all transaction records to the audit card. Instead, to conserve memory, step **10** filters some coupon transactions out of list **132**. Step **20** reads list **132** as a circular list, and writes all transactions between the indices stored in the variables TRAILING and LEADING.

FIG. **29** shows a processing performed by processor **860** and program **845'** in dispensing unit **115'**, to effect steps **10** and **20** of FIG. **28**. The processing of step **45** of FIG. **29** is similar to that of step **45** of FIG. **12**, described above in connection with the first preferred embodiment. In addition, step **45** of FIG. **29** performs the variable assignment LEADING=TRAILING=0. The processing of step **25** of FIG. **29** is similar to that of step **25** of FIG. **12**, described above in connection with the first preferred embodiment, with the additional processing described in FIG. **30**.

FIG. **30** shows the processing of step **25** of FIG. **29**, sending a coupon to a customer card, in more detail. Processor **860** reads the date-time clock **862** (step **10**) and adds a record to dispensing list **132**. (step **20**). The record includes the read date-time and the customer identification data **2467**.

In step **20** of FIG. **30**, CPU **860** executes the following instructions:

```
T_ARRAY [LEADING, TIME]=time read in step 10

T_ARRAY [LEADING, CUSTOMER_ID]=customer ID data
  2467

LEADING=(LEADING+1) MODULO LIST_SIZE
```

wherein T_ARRAY is an array of the records in list **132**, the first record being accessible using an index of 0. Each record includes a TIME field for storing the date and time at which a coupon was dispensed. Each record also includes a CUSTOMER_ID field for recording the customer to whom the coupon was dispensed. MODULO is a function that returns the integer remainder of dividing the left argument by the right argument. LIST_SIZE is the size of list **132** in dispensing unit **115'**. Thus, the instruction, LEADING=(LEADING+1) MODULO LIST_SIZE implements a circular buffer.

In step **25** of FIG. **30**, CPU **860** conditionally trims the tail of the circular buffer by executing the following instructions:

```
IF DIFFERENCE (T_ARRAY [TRAILING, TIME],
  T_ARRAY [LEADING-1, TIME])>15 ! interval>15
    minutes
  AND
  LEADING—TRAILING+1 <50! less than 50 transac-
  tions in interval
THEN
  TRAILING=(TRAILING+1) MODULO LIST_SIZE;
  ! trim list
```

The function DIFFERENCE takes two arguments in the date-time format of the records in list **132**, and returns the difference in units of minutes.

Processor **860** then sends to the customer card a data block containing a type code indicating a dispensing unit, and coupon data **134**. (step **30**). Thus, processor **860** writes coupon data **134** into EEPROM **2462** of card **215**.

Thus, dispensing unit **115'** includes arithmetic circuitry for performing the arithmetic operations described above. Before service worker **50** creates a signal to dispensing unit **115'** by inserting auditing card **120**, dispensing unit **115'** stores the third signal, and reduces a length of the third signal using the arithmetic circuitry.

Thus, the dispensing units of the second preferred system filters some dispensing transactions from the transaction list, thereby conserving memory in the dispensing unit and in the audit card.

Thus, the first and second preferred systems each include a plurality of retail stores, each store having a coupon-dispensing unit for writing electronic coupons onto portable IC cards carried by each customer. To audit the system, store personnel insert an auditing card into the coupon-dispensing units, to collect the dates and recipients of coupon-dispensing transactions.

Although the preferred system employs an audit card, having an interface compatible with the customer card interface on each dispensing unit, the invention may be practiced with other types of auditing interfaces, disengaged from the dispensing unit except when auditing is performed. For example, instead of an audit card, a service worker may carry a portable computer that temporarily connects to the dispensing unit with a cable. With this cable scheme, the service worker creates a signal path to the dispensing unit by plugging the cable into the dispensing unit. The portable computer then receives an audit signal, through the cable, from the dispensing unit. Subsequently, the service worker breaks the signal path by disconnecting the cable from the dispensing unit.

Although the illustrated cards have been shown with a relatively simple memory organization, more involved memory organizations are possible, allowing a single card to function in other applications in addition to functioning in an embodiment of the invention.

Additional advantages and modifications will readily occur to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or the scope of Applicants' general inventive concept. The invention is defined in the following claims.

What is claimed is:

1. A method for a system including a plurality of first cards each having a first memory and respective first signal, a second card, a first computer that receives from the second card, and a store including a plurality of products, a central computer, and a checkout station having an electromagnetic detector and a checkout computer, the method comprising the step of:

sending a second signal to the first memory of a card in the plurality of first cards, the second signal corresponding to one of the plurality of products, and the following steps, performed in the store, of:

communicating product data between the central computer and the checkout computer;

receiving the first signal from the card in the plurality of first cards;

sending the first signal to the second card;

receiving, in the checkout computer, second signals from the card in the plurality of first cards;

receiving a third signal from the electromagnetic detector, the third signal corresponding to a product in the store; and

determining a price depending on whether the third signal corresponds to one of the received second signals.

2. The method of claim **1** wherein sending the first signal, from the second card to the first computer, includes sending a time signal to the first computer.

3. The method of claim **2** further including generating the time signal; and

reducing a length of the time signal.

4. The method of claim **1** wherein the store includes a plurality of interfaces, and the step of sending a second signal is performed in one of the interfaces.

5. The method of claim **1** wherein the store includes a plurality of interfaces, and the step of sending a second signal includes the step, performed in one of the interfaces, of receiving the second signal from the second card.

6. The method of claim **1** wherein the store includes a plurality of interfaces, and the step of sending a second signal includes the step, performed in one of the interfaces, of receiving the second signal from the second card after the interface detects the card in the plurality of first cards.

7. The method of claim **1** wherein the store includes a plurality of interfaces, and the step of the sending a second signal includes sending the second signal from one of the interfaces, at a time when the second card is touching one of the interfaces.

8. The method of claim **1** wherein the store includes a plurality of interfaces, wherein the step of sending the first signal to the second card includes sending a signal identifying one of the interfaces.

9. The method of claim **1** further including sending the first signal from the second card to the first computer, by sending the second card out of the store.

10. The method of claim **1** wherein the system further includes a third card, and the method further includes sending the first signal from the second card to the computer by sending the first signal to the third card, and sending the first signal from the third card to the computer.

11. A store for a system including a plurality of first cards each having a first memory and respective first signal, a second card, and a first computer that receives from the second card, the store comprising:

a plurality of products;

a central computer;

a checkout station including

an electromagnetic detector for generating a third signal corresponding to a product,

a checkout computer that communicates product data between the checkout computer and the central computer, and receives second signals from a card in the plurality of first cards;

a determiner that determines a price depending on whether the third signal corresponds to one of the received second signals;

a receiver that receives a first signal from the card in the plurality of first cards; and

a sender that sends the first signal to the second card.

12. The store of claim **11** wherein the receiver and sender are part of an interface having an electrical contact for touching the first card, and for touching the second card.

13. The store of claim **11** further including an interface that receives the second signal from the second portable card.

14. The store of claim **11** further including a clock to generate a time signal for sending to the second card.

15. The store of claim **14** further including logic to reduce a length of the time signal.

16. The store of claim **11** wherein the sender is configured to send a signal, identifying the interface, to the second card.

17. A card processing system in a system including a plurality of first cards each having a first memory and respective first signal, a second card, a first computer that receives from the second card, and a store including a plurality of products, a central computer, and a checkout station having an electromagnetic detector and a checkout computer that communicates product data between the central computer and the checkout computer, the card processing system comprising:

means for receiving the first signal from a card in the plurality of first cards;

means for sending the first signal to the second card;

means for receiving second signals from the card in the plurality of first cards;

means for receiving a third signal from the electromagnetic detector, the third signal corresponding to a product in the store; and

means for determining a price depending on whether the third signal corresponds to one of the received second signals.

18. The card processing system of claim **17** wherein the means for sending the first signal includes means for sending a time signal.

19. The card processing of claim **18** further including means for generating the time signal; and means for reducing a length of the time signal.

20. The card processing system of claim **17** further including an interface with a sender for sending a second signal to the card in the plurality of first cards, the interface acting to receive, the second signal from the second card.

21. The card processing system of claim **17** further including an interface with a sender for sending a second signal to the card in the plurality of first cards, the interface acting to receive the second signal from the second card after the interface detects the card in the plurality of first cards.

22. The card processing system of claim **17** further including an interface with a sender for sending a second signal to the card in the plurality of first cards, the sender acting to send the second signal at a time when the second card is touching the interface.

23. The card processing system of claim **17** wherein the means for sending the first signal to the second card includes means for generating a signal identifying the interface.

24. A store for a system including a plurality of first cards each having a first memory and respective first signal, a second card, and a first computer that receives from the second card, the store comprising:

a plurality of products;

a central computer;

a checkout station including

means for generating a third signal corresponding to a product,

means for communicating product data with the central computer, and

means for receiving second signals from a card in the plurality of first cards,

means for determining a price depending on whether the third signal corresponds to one of the received second signals;

means for receiving a first signal from the card in the plurality of first cards; and

means for sending the first signal to the second card.

25. The store of claim **24** wherein the means for receiving and means for sending are part of an interface having an electrical contact for touching the first card, and for touching the second card.

26. The store of claim **24** wherein the interface includes means for receiving the second signal from the second portable card.

27. The store of claim **24** further including means for generating a time signal for sending to the second card.

28. The store of claim **27** further means for reducing a length of the time signal.

29. The store of claim **24** wherein the means for sending includes means for identifying an interface.

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